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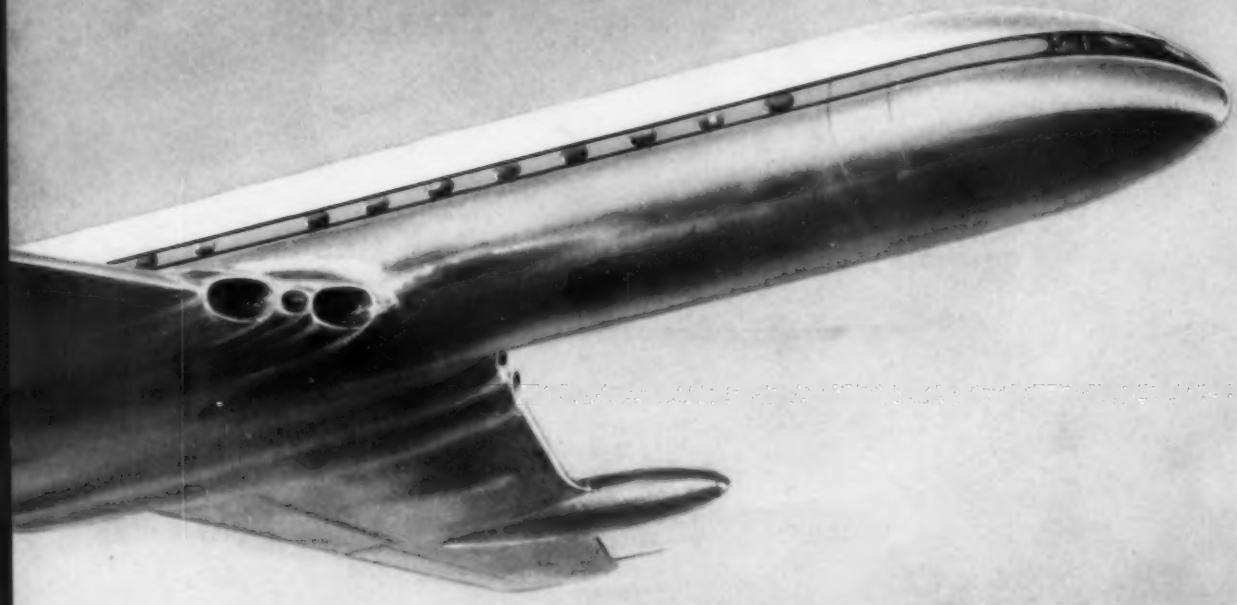

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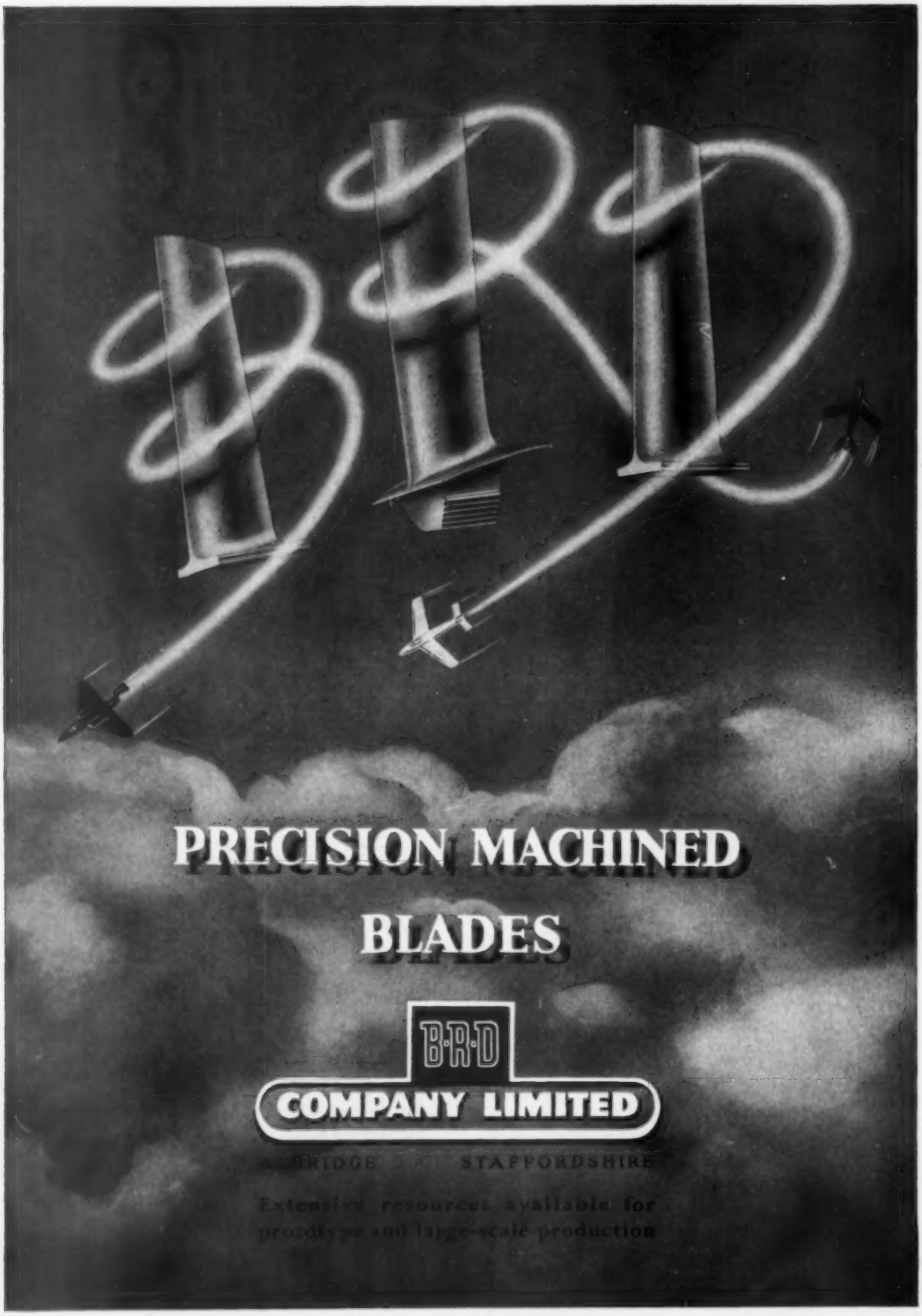
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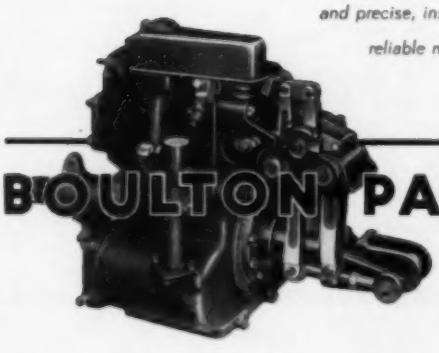

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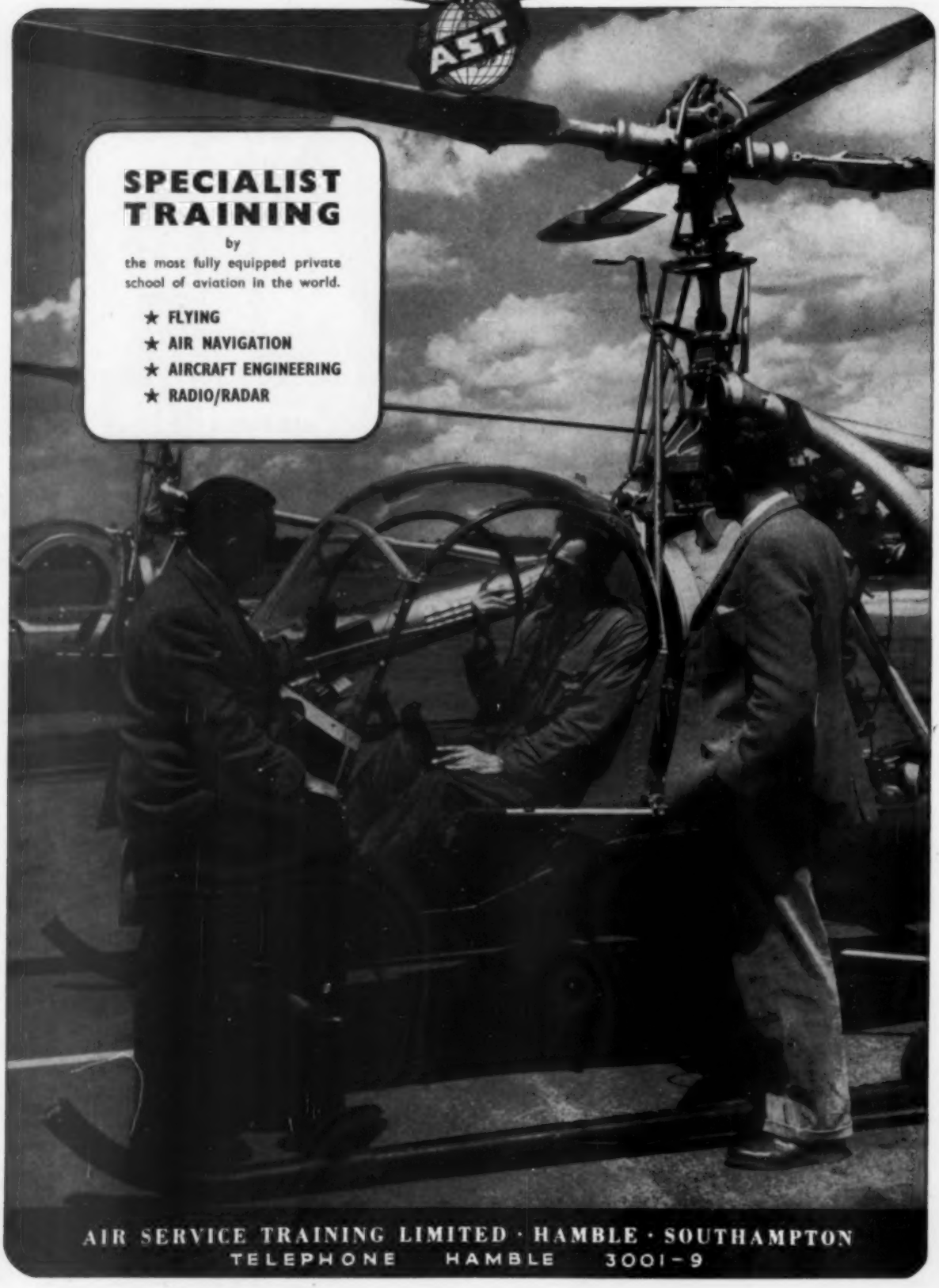

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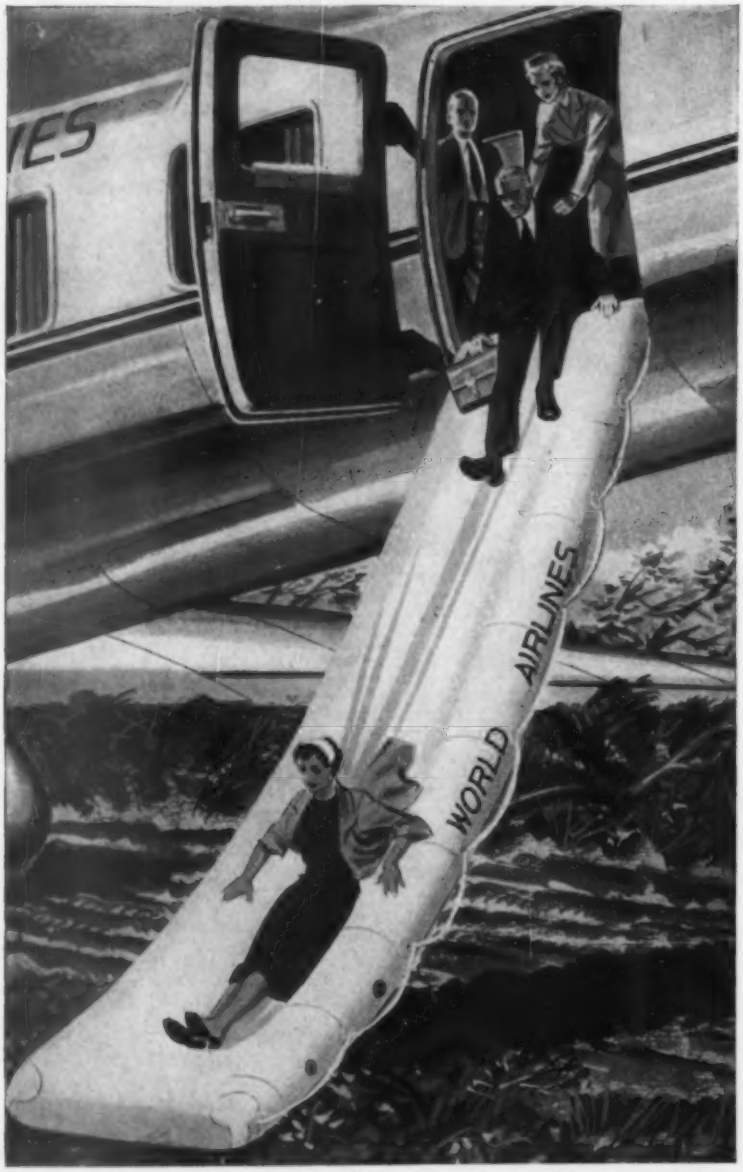
The Elliot Inflatable Escape Chute



The Elliot Inflatable Escape Chute takes only 9 seconds to inflate and has excellent rigidity. It is completely safe even with old people and babies.

THE PROBLEM of rapid escape from an aircraft which crashes on land becomes more acute with the increasing size of aircraft. From 1st January 1957, A.R.B. regulations require that all passenger aircraft with exits over 6 ft. from the ground must be fitted with some type of escape equipment.

The Elliot Inflatable Escape Chute meets this urgent need in a most effective way. Deflated and stowed, it takes up remarkably little space in the aircraft. A pull on the operating handle and it inflates automatically in 9 seconds from self-contained CO_2 bottles.

No need to be held in position

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Chutes are made in a variety of sizes to fit all types of aircraft. They are made from fire-resistant material.

The Elliot Chute is yet another example of Life-saving Equipment by the makers of Elliot Inflatable Dinghies and Life-jackets.

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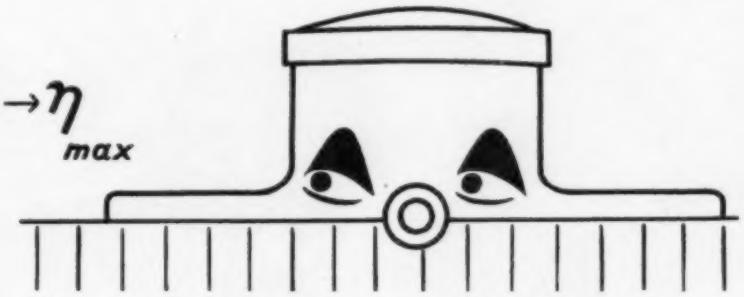

WOT MIGHT THAT MEAN ?

That, Mr. Head, is a Very Technical way of saying that the engine which makes you go 'round and 'round has a most efficient cooling system.

YOU MEAN IT HAS A BIG FAN ?

Au contraire, mon vieux, it has no fan at all.

WOT, NO FAN! HOW COME ?

Elementary, my dear Head. A very cunning exhaust ejector system is used to cool the engine.

I STILL DON'T GET IT. WOT'S THE POINT ?

The point is that we save a lot of weight and power, and reduce cooling system maintenance to negligible proportions.

AYE, BUT WHERE DOES IT GET YOU ?

It gets you in a position to lift nearly one ton of useful load with only 400 B.H.P. Why this surly attitude, old boy?

I'M JEALOUS. YOU HAVEN'T EVEN MENTIONED MY MERITS.

Sorry, Head, but you are such a simple uncomplicated fellow with no flapping or drag hinges or dampers, and you need so little attention because you are pressure oil lubricated, and you are so well protected from dirt, rain and ice, and you run so smoothly with no vibration that there really isn't a thing to say. Anyway, I'm sure your admirers know they can obtain complete information on the Doman-Fleet LZ-5 Helicopter by dropping us a line.

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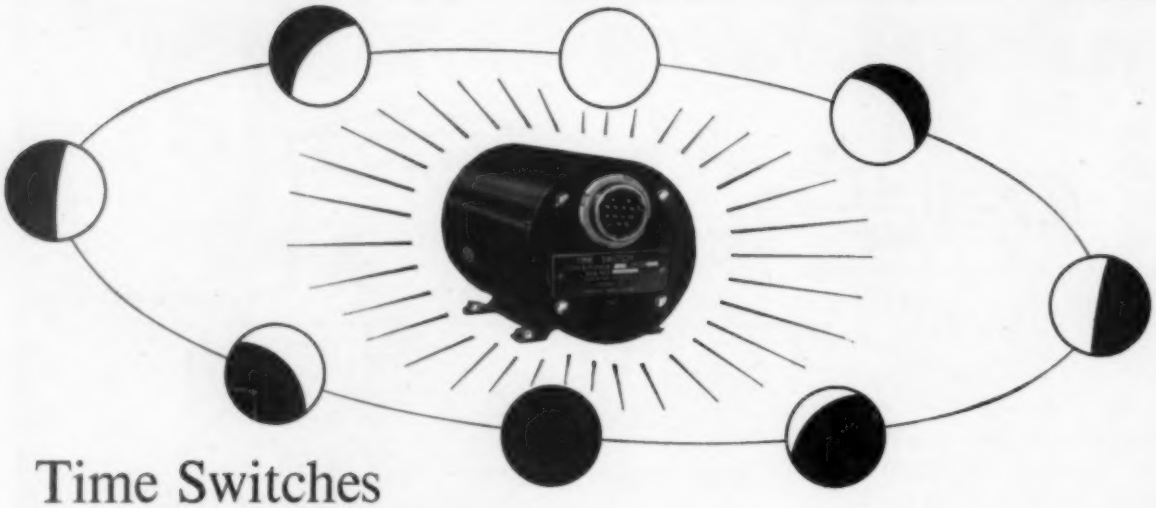

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Teddington precision time switches are powered by a 24V (nominal) D.C. motor which is governed to provide a constant speed over the wide variations of voltage and temperature encountered in aircraft. They provide multi-circuit sequencing with operating cycles ranging from 1½ seconds to one hour, and, where necessary, are fully suppressed against radio interference.

Satisfying all aircraft requirements for timed sequencing, these compact and lightweight switches have a minimum overhaul life of 1,000 hours. In the switch illustrated the sealed case can withstand an internal pressure of 20 p.s.i..

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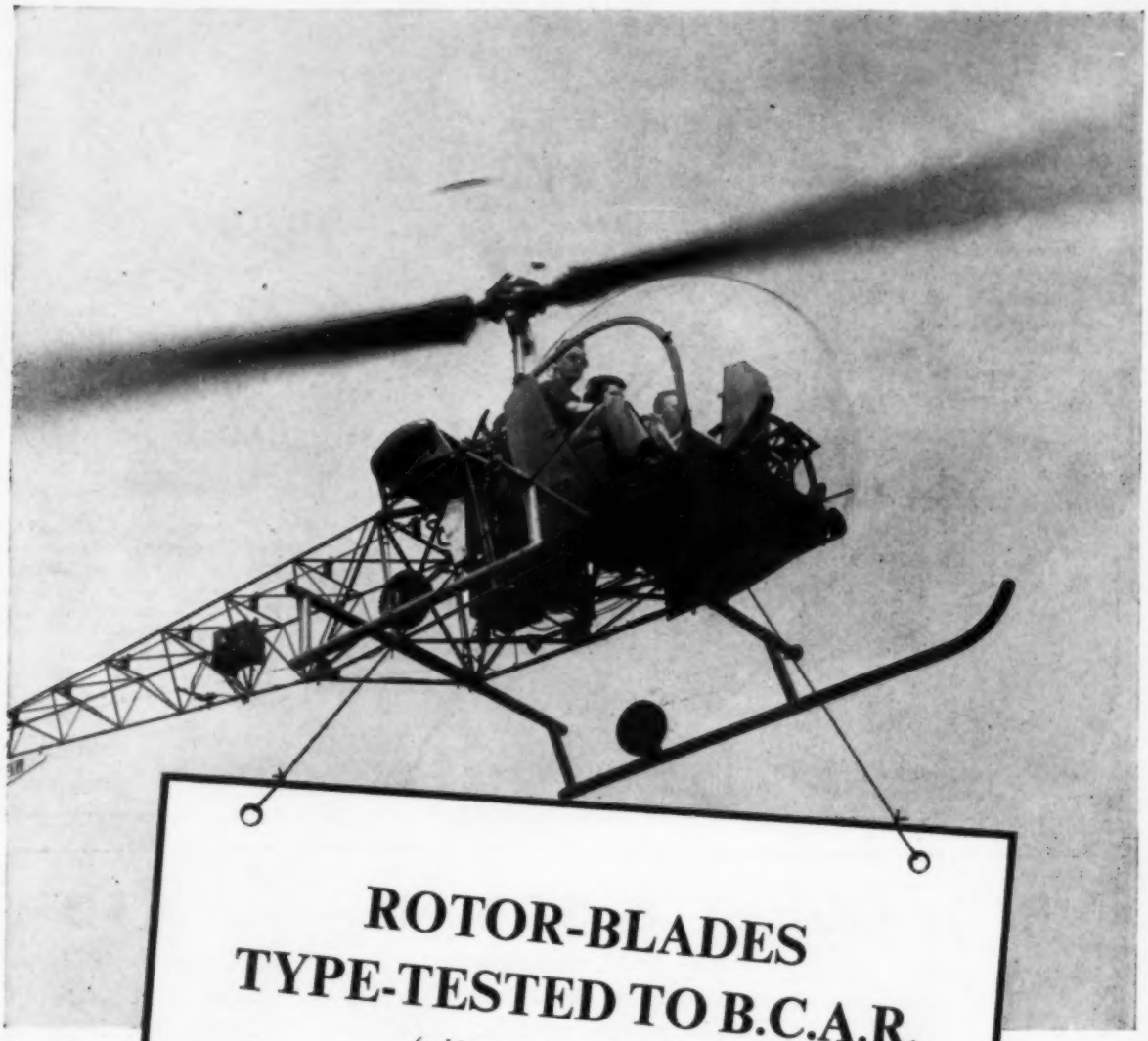

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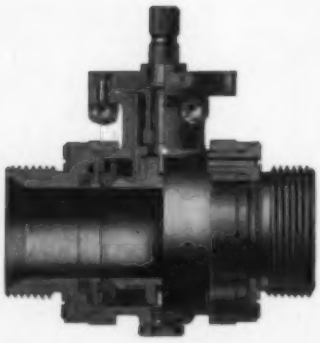
SAFE as  SAUNDERS

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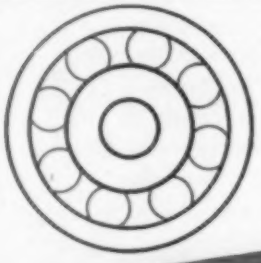

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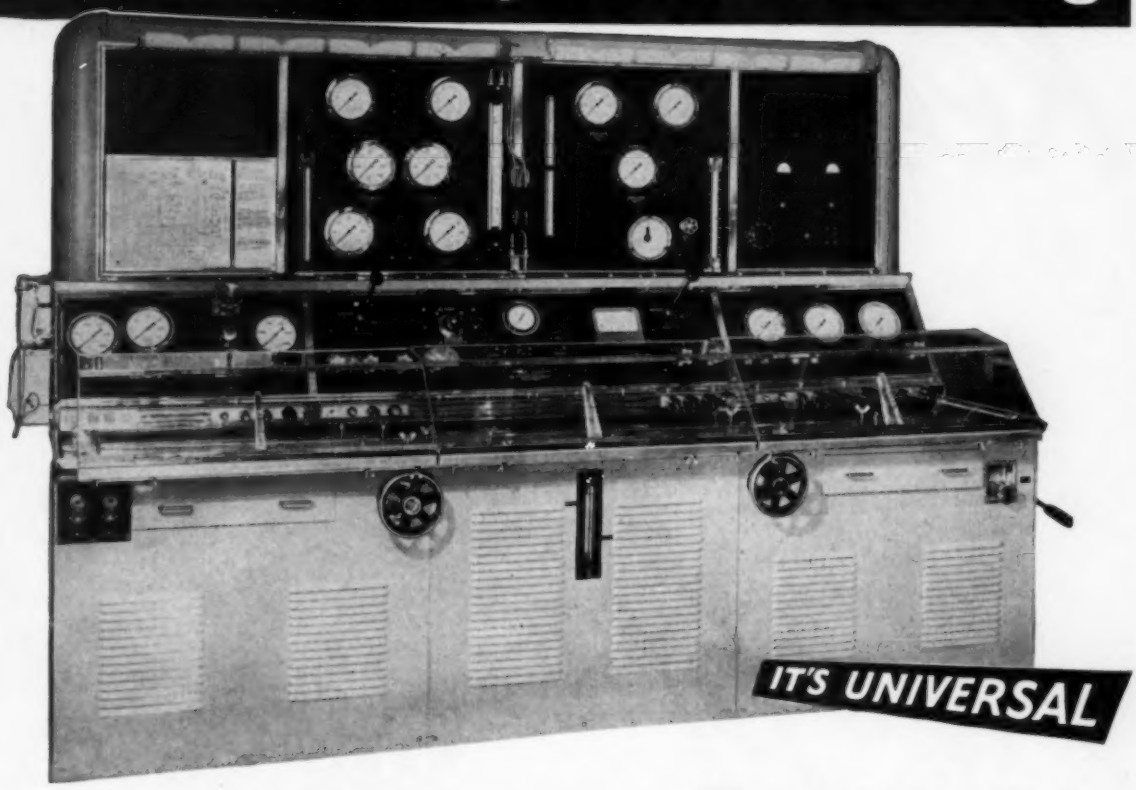
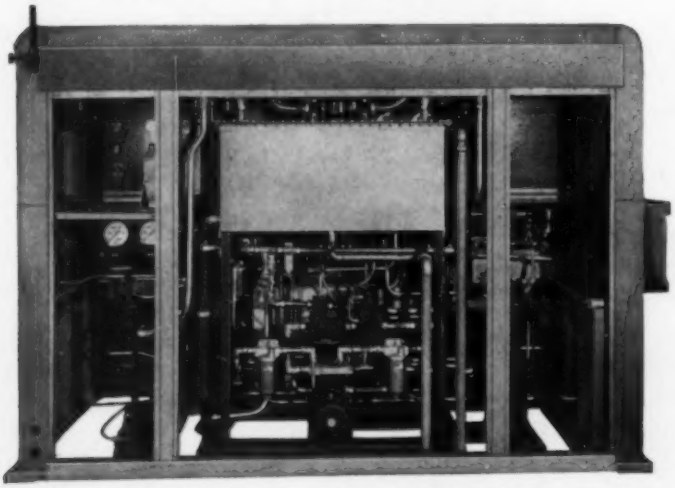


Full details and specifications gladly sent on request.



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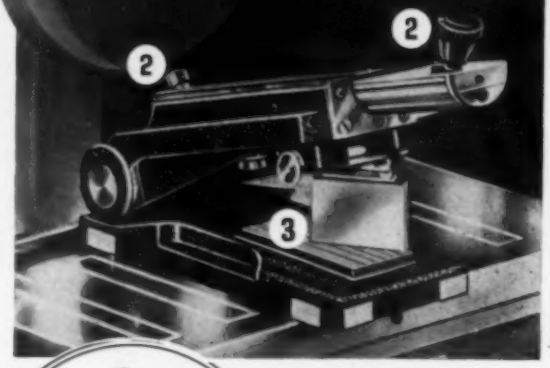

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2493 Vol 70 FRIDAY 2 NOVEMBER 1956

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Hatfield's Big Surprise

WONDERMENT—somewhat puzzled wonderment—must have been the general reaction to the news that a British jet airliner "comparable" to the DC-8 and 707 is to be constructed. To B.O.A.C.'s newly ordered fleet of 15 Boeing 707-420s is likely to be added, two years later, a sister fleet of de Havilland D.H.118s, similarly powered by Rolls-Royce Conway engines.

There can be few people who are not pleased at the prospect of all-British jet services across the North Atlantic, however much they may feel that the cart of prestige must never again be put before the horse of sound business. But we may be sure that if the D.H.118 were to be merely an instrument of national prestige, de Havilland would not be building it. It will demand an expenditure of technical effort as great as that now being exerted by the giants of the U.S. West Coast, of whose five-year 707 and DC-8 programmes it is still being said, "They'll never do it." It will, in fact, be a greater effort, since neither Boeing nor Douglas have yet seen fit to "phase-in" their 727 or DC-9 medium jets, whereas de Havilland are heavily committed to an accelerated Comet 4 and 4A programme. We are led to suspect that the de Havilland Enterprise, notwithstanding its great resources and jet airliner experience, may not be embarking entirely alone upon its new venture.

Questions and Answers

There must be coolly reasoned answers to the following questions: What is the market for a big jet transport coming three years after the first 707s and DC-8s? Will airline interest in the Comet, and the technical effort behind it, tend to be diverted to the 118? Why does B.O.A.C. need both 707s and D.H.118s?

The full answer to the first question must abide the release of more data as the basis of a fuller assessment; but from preliminary reports it appears that the D.H.118 will be smaller than the overwater DC-8 and 707 (120 tourists compared with about 150), though with equal Conway power. It will be lighter—perhaps not much lighter—than the first series of J57-powered Americans (240,000 lb to 260,000 lb); but since wing-loading will, we understand, be lower, airport behaviour (and therefore operational appeal) should be superior. And we may expect, despite the D.H.118's smaller capacity, a lower seat-mile cost. These assets should serve the 118 well in the world market—with the possible exception of the North Atlantic route, the operators of which appear to be fully stocked up with 707s and DC-8s. Total world traffic in 1962, excluding Russia and China, may be about 30,000 million tonne-km, of which 12 per cent may be North Atlantic traffic (it is at present about 6 per cent). This will require an aircraft capacity of about 6,000 million tonne-km to be available: just about exactly the potential capacity of the 150 overwater 707s and DC-8s so far ordered by eleven Atlantic operators, not to mention the 3,000 million tonne-km capacity of their 27 Britannia 310s, 111 DC-7Cs and 46 L.1649As. Although many of these aircraft will be used on other routes there would appear to be no immediate North Atlantic market for the D.H.118. If it is assumed that the 118 is not intended to be the ideal North Atlantic liner, and that its *raison d'être* is for the other long-range trunk-routes of the world, then its market could be extensive, even if stiffly competitive. Qantas, B.O.A.C.'s British Commonwealth partner, has just chosen the small version of the 707 for precisely such routes.

Might airline interest and technical effort tend to be diverted from the Comet 4 and 4A to the D.H.118? Airline interest will not, for the Comet is in the different medium-haul class. Technical effort should not, because the D.H.118 seems certain to have the fullest backing of the nation.

Why do B.O.A.C. need both 707s and D.H.118s? So that there shall be British-equipped and British-operated jet services on the world's intercontinental trunk routes. This will satisfy the Blimps: but it must also ensure the existence of a marketable world airliner—the only real foundation of Britain's mercantile prestige in the air.

FROM ALL QUARTERS

Vulcan and Valettas

IN written Parliamentary replies last week the Secretary of State for Air, Mr. Nigel Birch, made reference to the Vulcan accident at London Airport on October 1. He also mentioned the Valetta incident on September 24, in which several M.P.s aboard were hurt when the aircraft suddenly lost height.

The Minister announced that a further investigation of some aspects of the report of the Court of Inquiry on the Vulcan crash was to be undertaken immediately by the Minister of Transport and Civil Aviation, Mr. Harold Watkinson.

Subsequently it was stated that the Minister of Transport and Civil Aviation had ordered an independent private inquiry into "certain aspects" of the Vulcan accident; this was to be carried out by Dr. A. G. Touch, Director of Electronic Research and Development at the Ministry of Supply.

In the Commons last Wednesday Mr. Frank Beswick (Lab., Uxbridge) was to ask on whose authority the decision was made for the Vulcan to use London Airport as a return base on October 1; by whom the reception arrangements were made; and if the Air Minister would make a statement. He was also to ask what consultation took place between the Air Ministry and the Hawker Siddeley Group before the latter issued their statement as to the cause of the accident.

Of the Valetta, Mr. Birch said that the report of the Court of Inquiry showed that the accident [reported in *Flight* for September 28, p. 536] was caused by a defective valve in the amplifier unit of the automatic pilot. The defect was a most unusual one, but further tests are to be carried out. A temporary restriction is being placed on the use of the autopilot in certain Valettas.

Neville Duke Steps Down

THE announcement last weekend that S/L. N. F. Duke, D.S.O., O.B.E., D.F.C., A.F.C., would be relinquishing his appointment as chief test pilot of Hawker Aircraft, Ltd., as from October 31, owing to the "persistent recurrence of the spinal disorder" caused by his accident at Thorney Island last year, is a matter for very great regret; for Neville Duke's name has been associated—perhaps more than that of any other test pilot—with the development of high-speed flying in this country since the war. During his eight years with Hawker Aircraft, S/L. Duke saw the Hunter through from its prototype stages to squadron service. In 1949 he set up London-Rome and London-Karachi records in a Hawker Fury, and in 1953 he broke the world speed record with an average of 727.6 m.p.h. in a Hunter.

Clearly, Duke's injury was more serious than had been thought, and he was quoted in an interview as saying that he fractured his spine in the crash and that though he had been trying to keep going, first in a plaster cast and then in a plastic one, the strain had been too much. "Compression was the trouble," he said.

Fortunately, his disability will not debar him from civil flying; and the announcement said that although he had not made up his mind about his future, he would be unlikely to leave the aviation world entirely.

FAIREYS IN FORCE: At the recent Royal Aero Club dinner to record-breaker Peter Twiss: Professor R. L. Lickley, chief engineer, Fairey Aviation Co., Ltd.; Mr. G. W. Hall, assistant managing director; and the guest of honour.

KNIGHT AND VISCOUNT: Sir Thomas and Lady Sopwith chatting with Capt. L. S. Anderson of T.C.A. at Montreal Airport before leaving for New York on their first flight in a Viscount. Sir Thomas, chairman of the Hawker Siddeley Group, had been visiting part of the Canadian aircraft industry.

New Saunders-Roe Test Pilot

Lt-Cdr. Overbury.

THE holder of two international point-to-point records, Lt-Cdr. J. R. S. Overbury, R.N. (retd.), has joined Saunders-Roe, Ltd., as a test pilot under S/L. J. S. Booth, D.F.C., their chief test pilot. In 1954, Lt-Cdr. Overbury flew a Sea Hawk from London to Amsterdam at a speed of 571.5 m.p.h. and the following year piloted a Sea Venom from Rome to Malta at 531 m.p.h.

He joined the Royal Navy in 1943, trained in Canada and thereafter served with 810 and 812 R.N. Squadrons in the aircraft carriers H.M.S. *Ocean* and H.M.S. *Theseus*.

Lt-Cdr. Overbury qualified as a flying instructor in 1950 and in 1951/52 was training flight commander at the Royal Naval Air Station, Lee-on-Solent. In 1953 he graduated from the Empire Test Pilots' School and for the next two years served with the Royal Naval Test Squadron at Boscombe Down.

Hunter Home

THE Hawker Hunter T.7 which on October 20 flew from London to Rome at 566.1 m.p.h. made a return journey on October 25 which is also likely to rank as a point-to-point record. The crew of the two-seat Hunter again consisted of A. W. ("Bill") Bedford, Hawker deputy chief test pilot, and Frank Murphy, former production test pilot and now Hawker's R.A.F. liaison officer. Subject to confirmation, they covered the official distance of 891.67 miles in 1 hr 40 min 9.7 sec, an average speed of 533.93 m.p.h.

During its stay in Rome the Hunter was shown to the Italian Air Force. Fifteen demonstration flights were made, and the aircraft was handled by a number of senior officers, including the C.A.S., General Rafaelli. It appears to have given a very favourable impression.

A.W.650 Team

THE composition of the design team which is to handle the development of the Hawker Siddeley Group's new civil aircraft project, the Armstrong Whitworth 650-series freighter/coach has now been announced. Headed by Mr. E. D. Keen, chief designer of Armstrong Whitworth, the team has been established at the company's new £1 million research and design centre now being completed at Whitley, near Coventry. The project is under the direction of Sir Arnold Hall, technical director, Hawker Siddeley Group, Mr. H. M. Woodhams, managing director, Armstrong Whitworth, and Mr. Keen.

Mr. Keen states: "Now that the pattern of our design work for the next few years has become clear, we have decided to reorganize our technical departments in order to streamline our work. Mr. H. J. Staite has been appointed chief project engineer and will lead a small, complete team of designers, structural

MIXED-POWER INTERCEPTER. This S.O.9050 Trident II turbojet-cum-rocket intercepter—a tall-undercarriage development of the S.O.9000 Trident I—has now made over a hundred flights, many at high supersonic speed. The makers claim that the ceiling is "at present limited only by the pilot's vulnerability at extreme altitude." The SEPR rocket now has two, not three, barrels.

engineers and aerodynamicists to study new projects. He will be responsible directly to me for this work. This now allows maximum concentration of our other staff on the freighter/coach as follows: Mr. D. A. Woodley, assistant chief designer (technical); Mr. R. Dean, assistant chief designer (projec.s); and Mr. H. F. Butler (project designer, A.W.650). In addition, Mr. A. J. Troughton has been appointed chief structural and mechanical engineer, and will be responsible for structural design, mechanical testing and the analysis of testing of all aircraft systems. Mr. D. L. Raffle has been appointed chief performance engineer and will be responsible for aerodynamics, performance and operating economics. His duties will include direction and appreciation of the wind tunnel programme."

The new A.W.A. research and design centre, announced in June last year, includes design offices, laboratories and experimental shops in modern buildings, which are replacing the company's old production plant at Whitley.

Hawker's New Fighter

SPEAKING in the House of Commons on Monday the Minister of Supply, Mr. Reginald Maudling, stated that the Hawker Siddeley Group were developing a new piloted fighter as a private venture. It is understood that the design, by a Hawker team led by Sir Sydney Camm, was refused a development contract by the Ministry of Supply, although it is reported that 1,800 m.p.h. is aimed at, and that a prototype should fly in 18 months. Mr. Neville Spriggs, Hawker managing director, is quoted as saying "The project is going very well. It will be remembered that before the war we undertook as a private venture the development of the Hawker Hurricane, and we believe that the same kind of private initiative should be shown in the present circumstances."

Smiths Director of Research

TWO years ago Mr. G. G. Roberts, M.Sc., A.F.R.Ae.S., joined Smiths Aircraft Instruments, Ltd., and was given charge of their guided-weapons programme. He has now been appointed the company's director of research, in which post he is responsible for all weapons and aviation research. After gaining distinctions at two universities (Wales and London), Mr. Roberts was engaged on lecturing; then he joined the Ministry of Aircraft Production, in which he worked at the Telecommunications Research Establishment on radar development. After the establishment had moved to Great Malvern he worked on airborne applications of centimetric radar and was eventually in charge of the group responsible for A.I. radar in Service aircraft. Shortly after the war he investigated cloud-and-collision-warning radar and for a time collected data in the Singapore area. He went over to guided-weapon work in 1947, joining the staff of the R.A.E. at Farnborough. As senior principal scientific officer he was in charge of the weapons division of the Guided Weapons Department.

Mr. Roberts.

Beaulieu Landing Fine Reduced

THE appeal made by Mr. Norman Jones against a fine of £200 imposed on him by Lymington magistrates for landing his Tiger Moth at Beaulieu R.A.F. airfield on March 17 was heard by the Hampshire Quarter Sessions Appeals Committee at Winchester on October 26, and resulted in the fine being reduced to one of £50.

Mr. A. C. Munro Kerr, for the respondents (the police), said Mr. Jones left Fairoaks on the morning of March 17, his flight plan indicating that he was going to Brockenhurst, where his wife was staying at an hotel. The only aerodrome near there is Beaulieu, where the runways were marked with white crosses. After Mr. Jones had landed he was taken to the guard room and questioned. He then said: "I have had enough of this. Who do you think you are? Do you think this is Russia? I have every right to land here, provided I do not endanger life." Mr. Kerr observed: "Had this man (Mr. Jones) taken a sensible attitude, the justices might have taken a different view."

Mr. W. A. Fearnley-Whittingstall, Q.C., for the appellant, said that Mr. Jones felt that in this country the hand of people was raised against those who fly privately; he considered the penalty to be out of all proportion to the offence, having thought he would either be fined a nominal sum or discharged. It was quite wrong to suggest that Mr. Jones "always intended to land at Beaulieu"; he intended to land on a grass field—as one should do in a Tiger Moth. On his map Beaulieu aerodrome appeared to be not recognizably either civil or military: he did not think he was going to land upon a military aerodrome. He noticed the white crosses on the runways at Beaulieu and knew what they meant, but he intended to land on the grass there—which he did. "There was no intention whatsoever by this gentleman to flout the law," said Mr. Fearnley-Whittingstall. "I hope you will come to the conclusion that the penalty is out of all proportion to the offence."

Cross-examined by Mr. Munro Kerr, Mr. Jones was asked: "Are you under the impression that people are hostile to those who own aircraft?" Mr. Jones replied: "Yes. I want to assert the rights of people who do." He admitted he owned "five or six" aircraft and when asked whether he could find the money to pay the £200 fine, said: "I expect I could."

Giving the committee's decision the chairman, the Hon. Ewen Montagu, Q.C., said that in the circumstances, including the way Mr. Jones had treated the court at Lymington, they were not surprised the magis rates had decided he had deliberately flouted the law. But now, having seen him and heard his evidence, the committee did not consider his attitude was as bad as that, nor his offence as bad as that. They thought a pilot of his experience knew Beaulieu airfield was not disused at the time, but decided to "chance his arm".

"He has substantially succeeded," concluded the chairman, "but there will be no order as to the costs of this hearing, as he brought the necessity for this appeal upon himself by his own actions."

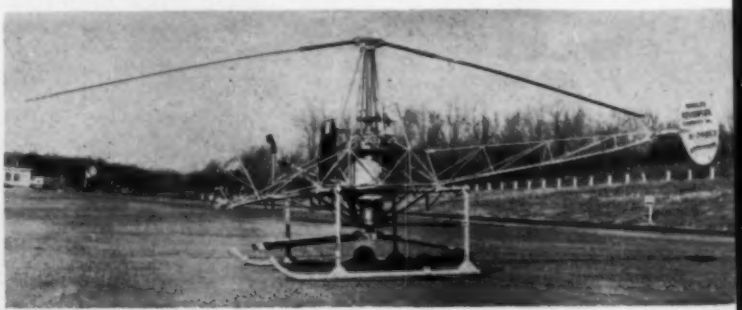
The committee decided not to alter the order for £30 17s 6d costs imposed by the magistrates' court at Lymington.

Exports Still Increasing

THE September total of British aircraft industry exports, £7,728,584, brings the aggregate for the first nine months of 1956 to £80,786,663, which is an increase of 71.5 per cent over the same period during 1955, itself a record year.

Of the £80¾m total, the sale of aircraft brought £56.7m, engines £20.7m, electrical equipment £1.9m, tyres £491,000, and instruments just over £1m. The Minister of Supply said last Monday that the year's total of complete aircraft exported was expected to be 727, worth £105m.

OVER AND UNDER: Although not immediately apparent, this Nagler NH-160 helicopter (the picture was received too late for inclusion in our main helicopter-review section) has twin rotors. The crankcase of the McCulloch engine drives the upper rotor, and the crankshaft drives the lower, thus eliminating transmissions and gearboxes.



FROM ALL QUARTERS . . .

High-altitude Fashions

DETAILS have just been released of the special clothing worn by Bristol test pilot Walter Gibb during high-altitude test flights. The partial pressure suit, examples of which have been produced by both G.Q., Ltd., and Frankenstein and Sons, Ltd., is worn with a standard Mae West. The two pictures on the right show different types of partial pressure helmet. That at left is made by G.Q. and was worn by Gibb during the Olympus-Canberra altitude record flight to 65,890ft on August 29 last year. At right, Gibb is wearing a more advanced, plastic-domed partial pressure helmet by Baxter, Woodhouse and Taylor, Ltd. It has a transparent visor and a feeding orifice. The plastic dome gives protection to the forehead and crown of the head, but does not cover the back of the head and neck. A similar helmet, with an internal anti-glare visor, was shown in the S.B.A.C. static display this year.

Partial pressure garments, designed for use in case of cabin pressure failure at very high altitude, provide pressurization by mechanical constriction of the body. This is achieved by inflation of pipes running along limbs and body through loops of fabric attached to the suit. Lacing ensures a tight fit. The helmets contain special inflatable pads. Another form of protection is afforded by the pressure jerkin, g-suit and partial pressure helmet. Equipment of this type is being worn by English Electric test pilots and pictures of it appeared in *Flight* on June 22. Jerkin, with integral "Mae West," and g-suit were in this case by Frankenstein, and helmet by M. L. Aviation, Ltd.

PARTIAL PRESSURE: Two types of partial pressure helmet, together with a partial pressure suit, are modelled by Bristol assistant chief test pilot Walter Gibb. Further details appear in the accompanying news item.

Getting his Own Back

A GRUMMAN F11F-1 Tiger has been destroyed after being struck by 20 mm solid cannon shells fired by its own four guns. U.S. Navy reports on the accident state that during gun-firing trials off Long Island the aircraft was put into a shallow dive at 880 m.p.h. The pilot fired two four-second bursts one after the other. Immediately after the second burst, his windscreen was shattered by what he thought was a bird. It was one of his own shells. Two others hit the nose and engine respectively, and the pilot was seriously injured in making a forced landing near his base.

The probable explanation is that the shells, though travelling 1,500ft/sec faster than the aircraft when they left the barrels, rapidly slowed down and began to fall away. The Tiger increased its angle of dive after firing and caught the shells up some three miles from the point of discharge. Despite the improbability of a recurrence, test pilots have been warned to turn aside or slow down after firing.

Support for A. Cdre Banks

IN a letter to *The Daily Telegraph* last Friday Sir Roy Fedden, the eminent aeronautical engineer, supported the criticisms of British aircraft production methods made by A. Cdre Banks in his recent lecture to the Royal Aeronautical Society.

After referring to the Air Minister's "petulant outburst" about the lecture, and recalling what he termed "an unfortunate 'soothing syrup' White Paper on the aircraft supply position, published about 18 months ago, Sir Roy went on to say:—

"It does not seem to be appreciated that Air Commodore Banks has not criticised our basic designs or the new ideas produced by our technologists over the period under review, and there is therefore no need to defend them. He is rightly concerned about the lack of skill and expedition with which they have been brought to fruition.

"The Press picked up his comment about the Swedish Air Force, but I feel entirely misinterpreted it. What I read into it was that the Swedes, post-war, developed a clear-cut air policy and carried it out effectively, and this resulted in their having a better equipped Air Force for their particular requirements than we have, due to our ineffectual handling and lack of correct timing."

[The first part of A. Cdre. Banks' lecture, containing the remark about the Swedish Air Force, was reprinted in *Flight* last week; the second and concluding part will appear next week.]

American Farmer

FIRST flight of the Transland Ag-2 agricultural aircraft was made on October 11 by Robert Masterson from Torrance Municipal Airport, California. Designed by George S. Wing, president of the Transland Company, the new machine is equipped for the fire-control and pest-control of forests as well as the customary dusting and spraying of crops.

The Ag-2 is a development of the experimental Ag-1 which was built at Texas A. and M. College under the direction of Prof. F. E. Weick and with the assistance of the U.S. Aeronautics Administration, the Department of Agriculture and the National Flying Farmers' Association. Claimed to be "the world's first aircraft to be designed specifically for aerial application of agricultural and forest lands," the Ag-2 is nevertheless the fourth new agricultural aircraft to appear this year.

Powered by a 450 h.p. Pratt and Whitney engine, the machine incorporates separate dispensing systems for solids and liquids. A 53 cu ft hopper (located in the fuselage) holds 2,000 lb of low-density solids, while four wing-tanks have a total capacity of 250 U.S. gallons. Other equipment includes spray booms, agitator gate, spreader, engine-driven pump and valves.

The balance of flight tests for C.A.A. Part 3 certification of the machine is expected to be completed by the end of the year. "A very enthusiastic response" is claimed from many government departments, ranch and plantation owners, forestry stations, rice planters in Thailand, top-dressing operators in New Zealand, cattle ranchers and farmers in North and South America, pine-apple and sugar plantations in Hawaii, and farm co-operatives in South Africa.

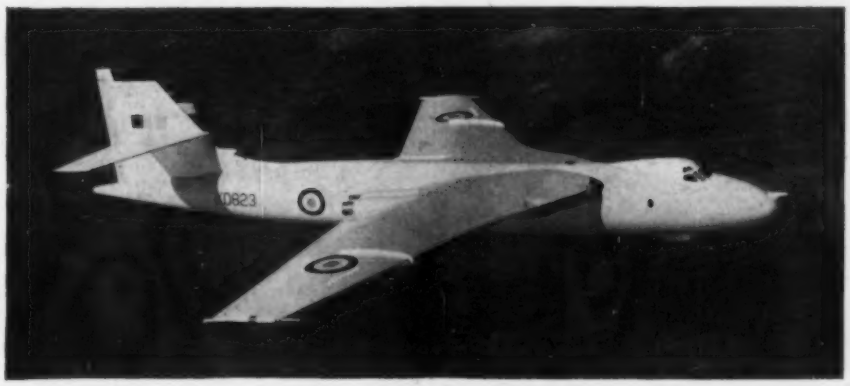
Ag-2 Data: Span 42ft; length 27ft 11in; height 9ft 8in; undercarriage track 10ft 10in; empty weight 3,038 lb; useful load 2,962 lb; design gross weight 6,000 lb; payload 2,000-2,500 lb; fuel capacity 125 U.S. gal; construction: all-metal, riveted aluminium alloy 24ST Alclad (with protective coating against corrosive chemicals); wing section, NACA 64021; normal cruise 142 m.p.h.; typical performance, 80 m.p.h. with full load (and flaps down) on 58 per cent power; performance on first flight, take-off distance under 400ft at gross weight of 4,033 lb; rate of climb 1,400ft/min at normal rated power.

BACK TO THE LAND: The Ag-2 lands at Torrance, Calif., after its first flight (see above).

WHITE KNIGHT

AND a valiant knight forsooth; even a knight at arms alone, in a place where no birds sing; but assuredly not one palely loitering . . .

Our V-bombers are now being turned out with a special white finish which, kept clean, strongly emphasizes their handsome lines. (Protection against atomic-weapon flash has been quoted as the reason why certain American bomber types are being given white under surfaces.) These fine pictures, by "Flight" photographer L. W. McLaren, show a new Vickers-Armstrongs Valiant B(PR)K. 1, and complement the illustration of a white Victor B.1 published in our issue of September 21.



The crew who flew for the photograph were (left to right, above) J. C. Knowles, flight-test observer; F/O. G. Potter, R.A.F. navigator on attachment to Vickers; Tony Jones (co-pilot), an Avro test pilot doing Valiant training; Eddie McNamara, V-A. production test pilot; and Colin Allen, production test pilot who flew the photographic Valetta.

HERE AND THERE

F-84Fs for the Luftwaffe

AT Fürstenfeldbruck airfield, Germany, on November 13 the first delivery of American F-84F Thunderstreaks to the new Luftwaffe is due to take place. These 20 aircraft are intended to form part of a squadron commanded by Maj. Barkhorn.

French F-86Ks

FIRST deliveries of Fiat-built North American F-86Ks have been made to the 13th Escadre of the French 1er C.A.T.A.C. at Lahr, Germany. Three F-86Ks were flown by French pilots from Istrana, Italy, to Lahr last mon h and 31 Americans are helping to train pilots and ground crews.

Turboprop Challenger

A BRISTOL Proteus 705 is the intended engine for the car now being designed for an attempt by Mr. Donald Campbell on the world land speed record of 394 m.p.h., set up by the late John Cobb in 1947.

Camera Crane

CARRYING a 260-lb Vista-Vision camera, a Bristol Sycamore is being used by a French film company on location in Spain. The aircraft was flown out from Croydon to Almeria in Southern Spain, by Mr. John Crewdson, who specializes in helicopter charter work.

Jet Provost in America

A HUNTING Percival Jet Provost Mk 2 has completed its evaluation visit to the R.C.A.F. at Ottawa and Trenton, Ont., and is now being inspected by the U.S. Air Force and Navy in the Washington area. While in America the aircraft is being serviced by the Hunting associate company, Field Aviation Co., Ltd., of Oshawa Airport, Ont. When the machine was in Canada it was flown by a number of journalists who, it is reported, spoke well of its handling characteristics.

NAVIGATION BY NUMBERS: Figures five feet long, painted in the Automobile Association colours of yellow on a background of bronze blue, positioned by roadside telephone boxes and visible from a height of 1,000ft, form the Association's latest kindly aid for aerial "drivers." Key leaflets are being prepared showing the numbers and locations of the boxes.

Harmon Trophies Awarded

ON October 23 President Eisenhower presented to Mme. Jacqueline Auriol and G/C. John Cunningham the Harmon Trophies awarded to them earlier this year [see *Flight* for August 10, p. 211] for outstanding contributions to aviation.

Excelsior

YESTERDAY (November 1) two U.S. Navy officers were due to make an attempt on the world altitude record for balloons by ascending to about 75,000ft from the Minneapolis, Minn, area in a pressurized aluminium gondola suspended beneath a plastic balloon. The present record, 72,375ft, was set up in 1935 by Captains O. A. Anderson and A. W. Stevens of the U.S. Army.

Gen. Doolittle N.A.C.A. Chairman

ON October 17 Lt-Gen. James H. Doolittle, who led the B-25 attack on Tokio during the last war, became chairman of the U.S. National Advisory Committee for Aeronautics. He succeeds Dr. J. C. Hunsaker, who is retiring after 15 years as chairman.

Bells in the U.K.

THE firm of Hordern-Richmond, Ltd., of Haddenham, Bucks, have recently completed a satisfactory type-test of Bell helicopter rotor blades. The company are United Kingdom representatives for Bell helicopters.

Across the High Frontier

A HELICOPTER flew over the Andes for the first time in history when on October 17 a U.S. pilot, Joseph Massmann, took a Bell 47 from Santiago de Chile to El Plumerillo airport, Mendoza, Argentine. The minimum height of the Uspallata Pass is over 13,000ft, and the crossing was made at an altitude of 19,000ft in 1 hr 40 min.

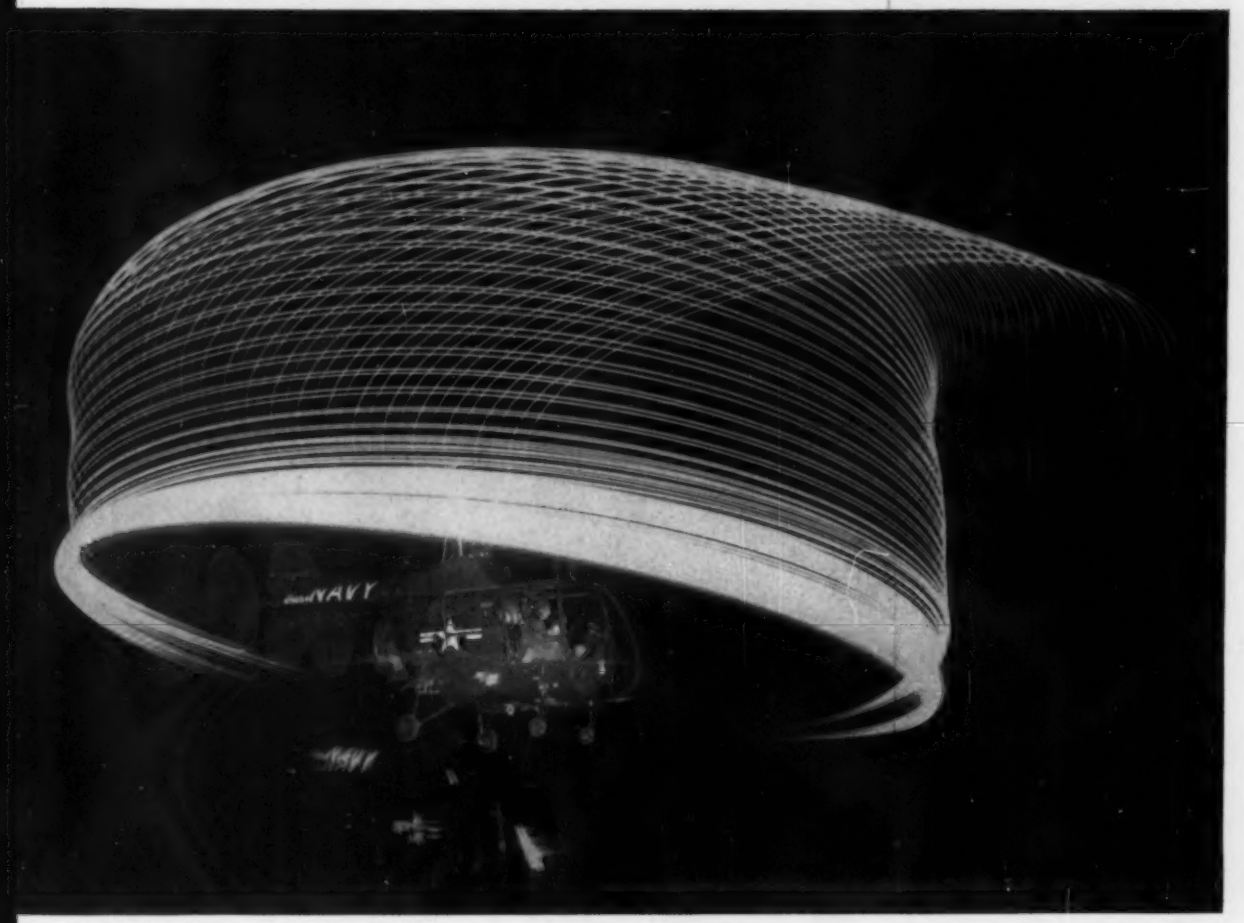
Too-low Solo

AT Brentwood, Essex, last week, Stanley David Foster, a musical director of Roll Gardens, Ilford, was fined £10 and ordered to pay £2 1s costs for flying at under 1,000ft. It was alleged that people in Shenfield could easily read the aeroplane's registration letters. Mr. Foster, who pleaded guilty, said his altimeter showed 700ft, which he considered a perfectly safe height.

Pictorial Aviation

RUSSELL ADAMS, chief photographer of the Gloster Aircraft Co., Ltd., is to judge the entries in the national aviation photographic exhibition to be held by the London Society of Air-Britain on Wednesday, November 7, at Caxton Hall, Westminster. He will also screen a number of his own colour films. Further details of the meeting are obtainable from Gerald V. Pollinger, 76 Dean Street, London, W.1 (Gerrard 7888).

ADOLF GALLAND, wartime head of the German fighter forces, came to England last week to attend the launching of the new book, "Fly for your Life," the story of W/C. Stanford-Tuck. He is here looking over the names on the famous autographed table-top at the White Hart, Brasted, Kent, where the party was held. Standing round him are (l. to r.) Battle of Britain pilots Tony Bartley, Brian Kingcome and Robert Stanford-Tuck.



HELICOPTERS of the World

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Helicopters of the World . . .

(Above and right) Bristol Sycamore.

GREAT BRITAIN

BRISTOL AIRCRAFT, LTD.

Filton House, Bristol.
(Filton 3831)

Sycamore (Type 171 Mk 4) Under numerous designations this basic type of general-purpose military or civil helicopter is widely in service. The centre part of the fuselage is a steel tubular structure to which are attached light-alloy monocoque nose and tail sections. For normal communications flying there are seats for a pilot and four passengers, and provision is made for a winch to be fitted on the starboard side. The rear entrances are closed by one of three means—panels fitted with large, fixed, jettisonable Perspex windows for all rôles other than ambulance and search and rescue; Perspex blisters for the ambulance rôle; or a canvas door on the starboard side for the A.S.R. rôle (the port entrance in this case can be closed by either a panel or a blister, as desired). Strong points under the engine bay allow for the carrying of external loads. Provision can be made for crop-spraying equipment, for the lashing down of freight, or for the installation of aerial public-address equipment.

The Alvis Leonides engine is mounted with its crankshaft vertical, and access to the engine bay is afforded by detachable panels in both sides, and underneath the centre fuselage. A cooling fan is driven directly by the engine, the air being taken through an intake above the cabin and discharged through the bottom of the engine bay. Hand-turning gear is fitted.

The rotor is of wooden construction, each blade consisting of an improved-wood leading edge, forming the main spar, with spruce and plywood ribs and plywood covering. The root portion of the trailing edge is of improved wood, and the outer portion of spruce. Brass nose-sheaths protect the leading edge and mass-balance the blade along the aerodynamic axis. The blades can be folded and stowed on a frame affixed to the rear fuselage; the tail rotor has three blades of similar construction to the main rotor blades, and is driven from the main rotor gearbox through a torque-limiting clutch by tubular transmission shafts. Main-rotor drive is through a single-plate centrifugal clutch, which automatically fully engages at about 1,000 r.p.m., a torque-limiting clutch, and a vertical shaft to the

Bristol Type 173.

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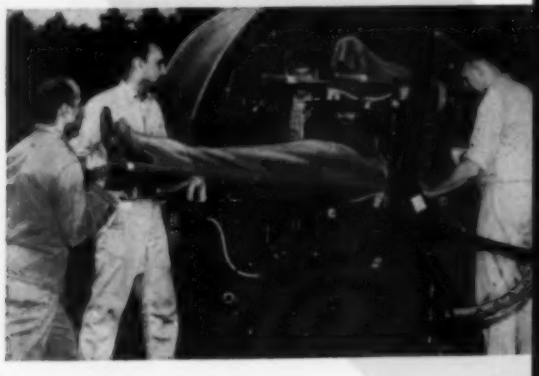

Helicopter

Transport

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The **KAMAN** *Aircraft Corporation*

BLOOMFIELD, CONNECTICUT, U.S.A.

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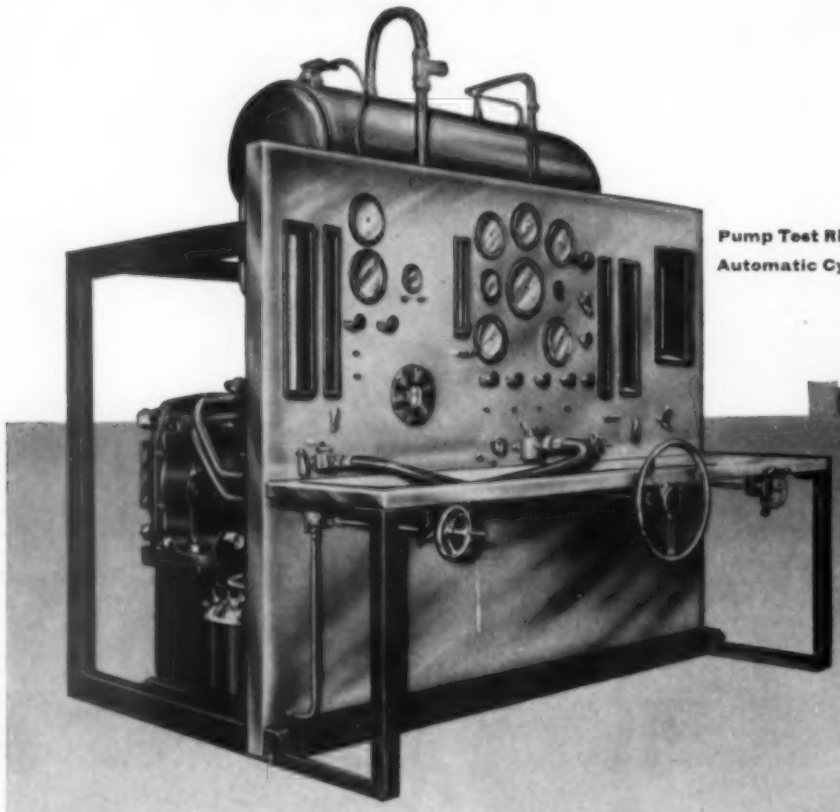

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In 1940, no available test rigs were suitable for our fuel systems; since then a wide range has been designed and produced by us. Today, with our vast technical resources, supported by immeasurable experience in this field, we can design and produce any specialised test rig you require.

- *Robust and compact in construction.*
- *High degree of accuracy.*
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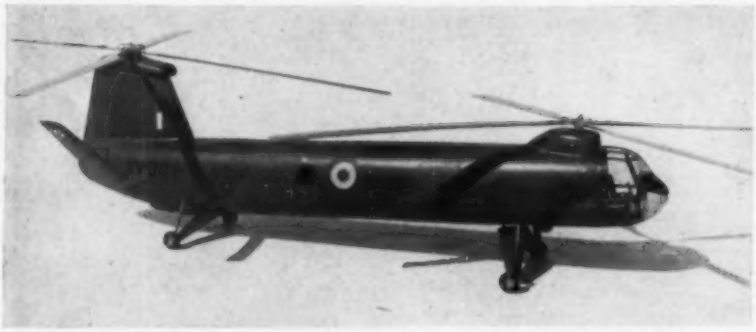
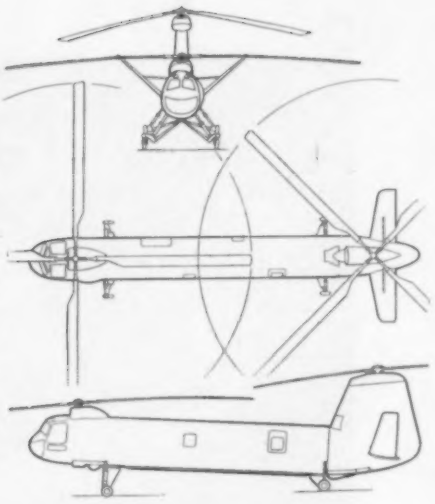




(Above and right) Bristol Type 192.

Helicopters of the World . . .

main gear-box. A flexible bag-type fuel tank, holding about 65 gallons, is mounted behind the rear fireproof bulkhead, and provision is made for an auxiliary tank of about 24 gal below the main tank.

● Rotor diam., 48ft 6in; overall length (rotors at extreme position), 61ft 1in; basic empty weight, 3,959 lb; gross weight, 5,400 lb; max. speed (5 min rating) at s.l., 126 m.p.h.; economical cruising speed at 2,000ft, 90 m.p.h.; rate of climb to rated altitude (6,000ft) at optimum climbing speed (57 m.p.h. approx.) at "1 hr" power, 840ft/min; hovering ceiling without ground effect, 4,000ft; hovering ceiling with ground effect, 8,400ft; service ceiling 15,500ft; max. endurance, 2.95 hr; max. still-air range (normal fuel), 267 miles; max. still-air range with auxiliary tank, 368 miles.

Type 173 Two prototypes of this twin-rotor helicopter are flying with Alvis Leonides piston engines; a third will have Leonides Majors, and the two final machines (completing the development batch of five) will be fitted with Napier Gazelle gas turbines. No quantity production is intended. One prototype has been fitted with improved horizontal and vertical tail surfaces and with new centrifugal droop-stops, which prevent the rotor blades from drooping excessively when stationary.

Type 192 Production of this twin-rotor helicopter for the Royal Air Force and the British Army will begin in 1958. Designed to meet the requirements for troop- and freight-carrying, ambulance duties and search and rescue, the Type 192 will at first be fitted with Alvis Leonides Major piston engines, but has been so designed that Napier Gazelle gas turbines can be substituted with the minimum of alteration. The layout is such, moreover, that while retaining the front and rear ends, with their associated controls, engines and drives, a different—shorter—centre fuselage can be substituted for naval operation. Similarly, a fuselage suitable for civil passenger operation can be substituted for the standard unit. Transmission and engine spares would be common to all three types.

The main fuselage—between the front engine compartment and the forward fin frame—is of constant ovoid section and is about 24ft long. The main entrance is covered by a canvas door except in cases where a winch is required, when the door is replaced by an upward-hinging jettisonable door carrying a winch and searchlight. A duct at the top of the fuselage carries the synchronizing shaft, flying controls and other services; a similar duct carrying additional services forms the bottom of the fuselage structure. The flight compartment can have dual controls, and a folding seat is provided alongside for a navigator, an instructor, or—when dual controls are fitted—a second pilot.

The front engine is mounted in a near-vertical position. The engine bay serves as a plenum chamber for engine- and gear-box cooling-air (admitted through an intake on top of the fuselage) and the engine is serviced through a large aperture in the under-side. One rear fuel-cell is located immediately forward of the rear engine-bay and a second cell is abaft the bay. On top of the fin is an air intake for the rear engine and rear and intermediate gearboxes.

Power is fed into the transmission system from the front engine to the front gearbox and from the rear engine to the intermediate gearbox; thus, in the event of one engine failing power is supplied to both rotors from one engine. A free-wheel between each engine and its respective gearbox ensures that no power can be fed back into the dead engine. The constant-chord main-rotor blades are of light-alloy construction with an extruded hollow D-section combined leading edge and spar. Aft of the spar the blade is made up of a number of separate sections bonded to the spar, each section being formed of thin skins bonded to pressed ribs. Various methods of folding the rotor blades are under consideration. The four-wheeled undercarriage is designed for a normal vertical landing velocity of 8ft/sec and an emergency landing velocity of 12ft/sec.

In the troop-carrying rôle the Type 192 will carry pilot, co-pilot or navigator (if required) and 18 men for long-range operation; for short-range work the seating could be re-arranged for 22 fully armed troops. A scrambling net can be attached to the lower sill of the doorway to assist in rapid embarkation or disembarkation. In the ambulance rôle the Type 192 will carry eight or twelve stretcher cases and three "sitting wounded." Provision is made for four electrically heated blankets and for blood transfusion equipment. A maximum distributed freight load of 6,000 lb can be lifted.

● Fuselage length, 54ft 3in; empty weight, 10,723 lb; gross weight, 17,200 lb; cruising speed (Gazelles), 138 m.p.h.; range with 14 troops (still air, with reserves for warm-up and take off), 218 miles. (Adoption of Napier Gazelles will approximately double the power for less weight and allow an increase in gross weight to 18,000 lb.)

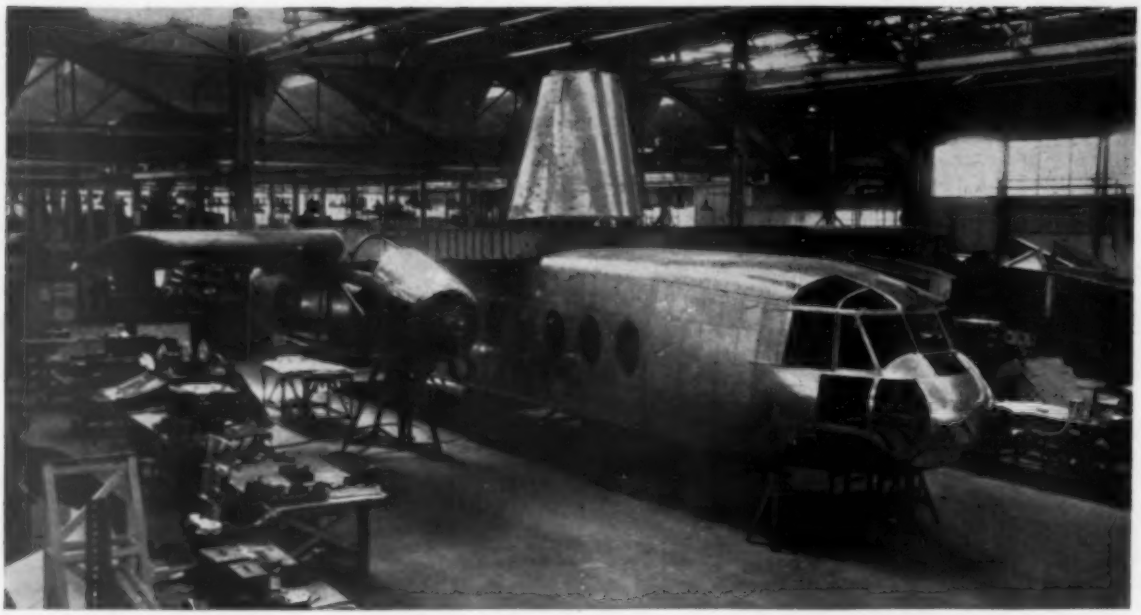
THE FAIREY AVIATION CO., LTD.

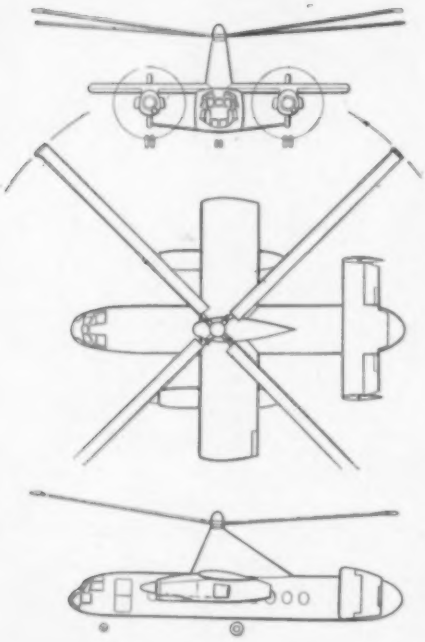
Hayes, Middx.
(Hayes 3800)

Jet Gyrodyne With this aircraft the Fairey company was the first in the world to make a complete and realistic transition cycle in flight, the feat having been achieved on March 1, 1955. By the following June the technique was well established. To date 190 transitions and 140 autorotative landings have been made and the basic technique of the operating procedure for the Rotodyne (later described) has thus been established well in advance.

It was the second of the two Fairey Gyrodynes, made in 1947 and 1948, which

Fairey Jet Gyrodyne.





(Above and left) Fairey Rotodyne.

Helicopters of the World . . .

was converted in 1953 into the Jet Gyrodyne. For this purpose a specially-modified Alvis Leonides was mounted with its crankshaft fore-and-aft in the fuselage, directly driving a gearbox from which two shafts led out along the stub wings to drive two variable-pitch pusher propellers of Fairey's own design. Small in comparison with the rotor disc area, the stub wings contribute very little lift. The pitch of the propellers is collectively and differentially controllable. A third drive is taken from the central gearbox to a friction-plate clutch and thence to two Merlin compressors mounted face to face under the rotor pylon. The rotor itself has no form of mechanical drive, air from the compressors being fed to thrust units at the rotor blade tips. The pitch of the blades is controlled in normal helicopter fashion by collective- and cyclic-pitch levers. Rudder pedals provide directional control by differential adjustment of the pitch of the two propellers. Duplicated Fairey Hydrobooster hydraulic, fully-powered servo units relieve this control of excessive forces.

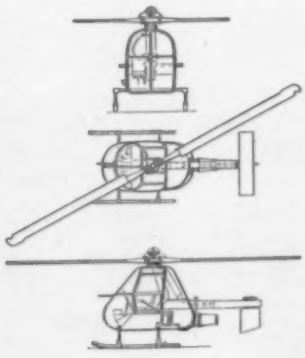
The aircraft is solely for research.

Rotodyne The essentials of this most promising large helicopter are a single lifting rotor, a fixed wing, and two propellers driven by Napier Eland turboprops. Each Eland also drives an hydraulic clutch which, when filled with oil, turns an auxiliary compressor feeding fresh air to the rotor at 4 atmospheres pressure and at 160 deg C. The turbine exhaust gas is passed overboard. At take-off the propellers are put in zero-thrust pitch and nearly all the power is absorbed in supplying the rotor with air, which is used to feed kerosine-burning pressure-jets at the tips of the four blades. At a suitable height the pilot moves the cyclic-pitch lever forward to tilt the rotor axis and so cause the aircraft to move forward. At about 100 kt power is gradually transferred from the auxiliary compressors to the airscrews until the Rotodyne is cruising solely on the thrust of the latter, with the rotor autorotating. To land, the process is reversed.

In his appraisal of the aircraft in *Flight* of August 17 last the Technical Editor wrote:

"Throughout, the keynote has been simplicity. The fuselage is a box, 8ft wide and 6ft high (in the first machine) with big clamshell doors at the rear end. The wing is a thick assembly with constant section from root to tip. Rotor control is —putting it bluntly—by brute force, in

(Left and right) Fairey Ultra-Light.



the form of Fairey's own Hydroboosters. The Rotodyne airframe will certainly have a far lower percentage structure weight than that of any other helicopter.

"One of the many troubles afflicting existing helicopters is rotor life. It is bad enough having to buy new blades for a small Hiller or Bell, but to ask operators to replace a giant 90-foot assembly, even every 1,000 hours or so, would be unreasonable. Accordingly, Fairey have taken the bold, and perhaps unprecedented, step of aiming at a rotor life equal to that of the rest of the airframe. The whole system is steel. Root fittings and head are machined from massive forgings in 90-ton steel and the blades themselves are stainless and should stand up well to bad weather. The tip jets are fed through three pipes anchored within the root of the lifting-aerofoil part of each blade (which starts about 10ft from the axis of rotation) and allowed to float axially within Fluon bushes. Chord is about 28in, and—like the rest of the airframe—the company's patented envelope-jigging principle is used."

The second Rotodyne, ordered a year ago and now occupying jigs, will be rather longer and will also have a square-section hull 8ft deep. It will thus be able to carry heavier loads of certain types of freight and will be better able to utilize the increased power of later Elands.

The rotor has been designed to the developed gross weight of 39,000 lb, and not to the 33,000 lb of aircraft No. 1; the cruising speed is now placed with assurance in the bracket 155-170 knots and not in the 130-kt regime originally envisaged; and, on the score of noise—which cannot be ignored with tip pressure-jets, particularly on a vehicle which could enter cities—a vigorous research programme has already lowered the sound energy by 10 db and promises to yield another 10, with a small thrust penalty. It is calculated that the take-off noise will be not worse than 95 db at 200ft—less than that of many existing transports. Furthermore, the very high rate of climb will rapidly take the Rotodyne above levels at which it could cause annoyance. Owing to the size of the rotor, the ground cushion is expected to be at least 100ft thick. Within it the Rotodyne should be capable of single-engine hovering.

● *First prototype, powered by two Napier Eland NEL.3 turbines rated at 3,000 e.h.p.*—Span, 46ft 6in; rotor diameter, 90ft; fuselage length, 58ft 8in; track, 24ft 6in; overall height, 22ft 2in; gross weight, 33,000 lb; disposable load, approximately 40 per cent of the gross weight; typical payload, 40 passengers on a 90-mile stage or 30 on a 210-mile stage, or about 10,000 lb freight.

Second prototype, powered by two Napier Eland NEL.7 turbines rated at 3,500 h.p.—Dimensions as for first aircraft, except for an increased fuselage length; gross weight, 39,000 lb; disposable load, about 16,000 lb; typical payload, 40 passengers for a 460-mile stage with full allowances (I.A.T.A. recommendation, 40-50 for a 200-mile stage); direct operating cost, 2¼d (3c) per seat mile (I.A.T.A. asked for 5c); cruising speed, over 170 m.p.h. (I.A.T.A., 150 m.p.h.); vertical rate of climb at maximum climb power, 1,670ft/min (I.A.T.A. requested 600ft/min); and full single-engined safety.

Developed Rotodyne with hot-turbine Elands rated at over 4,000 e.h.p.—As above, except that it will be possible to take 50 passengers on 430-mile stages with direct operating cost below even that of earlier Rotodynes.

Ultra-Light Of four Ultra-Light helicopters so far completed by the Fairey company, the last, which appeared in the S.B.A.C. Display this year, now incorporates hydraulic cyclic-pitch controls. This remarkable little aircraft is being developed as a private venture for civil and military applications, and following the recent modification, together with a redesigned, flexibly mounted rotor pylon, is reported to be exceptionally sweet to fly. A two-position variable-incidence tailplane is in view.

The Ultra-Light employs tip-jet drive, the jet at the extremity of each blade being fed with compressed air by a Blackburn Turboméca Palouste, which has an oversize centrifugal compressor for this purpose. Fuel is burned in each nozzle. The rotor is comparatively small—28ft—and the two blades form a see-saw combination, without individual flapping hinges. No drag hinges are employed.

For the civil version, recently announced, the all-up weight was increased considerably beyond that proposed for the original Army version; but despite the greater weight an improvement in payload/range is attained. A point of particular interest is that the flexibility of the powerplant installation allows the aircraft to be "tailored" for operation in extreme conditions of temperature or altitude. The makers recognize that the field of operation envisaged (e.g., communications, crop-spraying, transport of light loads in undeveloped areas, etc.) is already being exploited by existing light helicopters, but they remark that the Ultra-Light offers, by virtue of its ample power reserve, a great improvement in safety. In addition, they say, it can carry its load with an excellent vertical rate of climb in high temperatures and at higher altitudes than hitherto. The down-draughts encountered in mountainous terrain, they claim, become less hazardous with a machine having the Ultra-Light's characteristics.

● Rotor diam., 28ft 3in; overall length (less rotor), 15ft; gross weight, 1,900 lb; max. speed, 105 m.p.h.; cruising speed, 85 m.p.h.; vertical rate of climb, 1,300ft/min at s.l.; hovering ceiling, 6,000ft out of ground effect; stage distance with crew of two and 300 lb payload, 50 miles; stage distance with crew of one and 60 lb payload, 150 miles. The foregoing figures are for the civil version in temperate conditions (15 deg C. above I.S.A.).

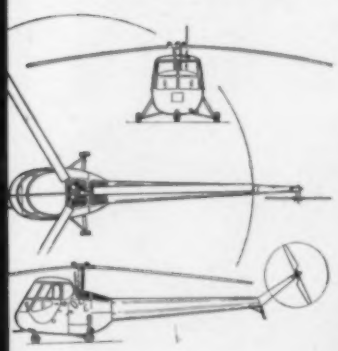
SAUNDERS-ROE, LTD.

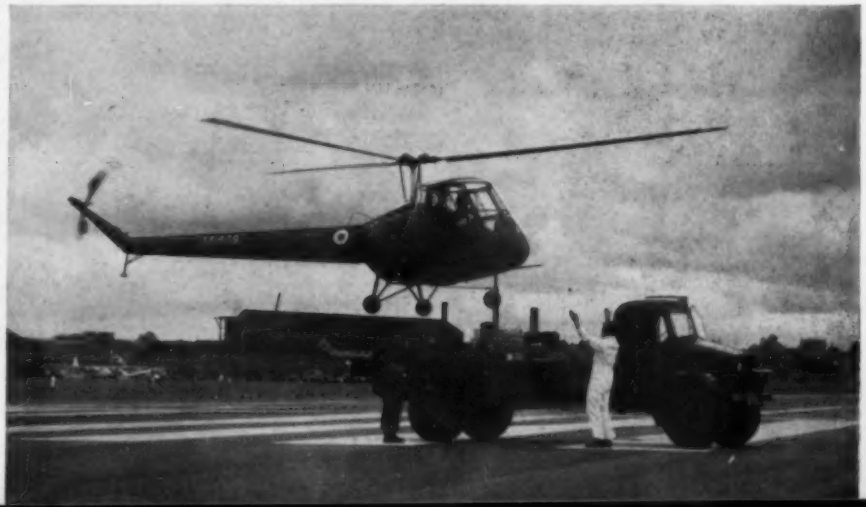
Osborne, East Cowes, Isle of Wight.
(Cowes 2211)

Skeeter Mk 6 From the basic Skeeter Mk 6 the military A.O.P.10 and the T.11 trainer have been developed. The Mk 6 itself is a derivative of the Mark 2, of 1949, and benefits from the 200 h.p. of the D.H. Gipsy Major 201 engine. Full dual controls are fitted, permitting the machine to be used as a trainer, but the seats are individually removable and a long-range tank may be fitted in place of the seat normally used by the observer. If required, this seat can be reversed to give a rearward view for A.O.P. work. The engine is installed transversely, the drive being taken from the rear end of the crankshaft on the starboard side. Fan cooling is provided through a starboard intake. In present versions the blades consist of a wooden secondary structure bonded to a steel tubular spar, the whole being covered with fabric; the leading edge has plywood covering. Bonded-metal blades are being developed.

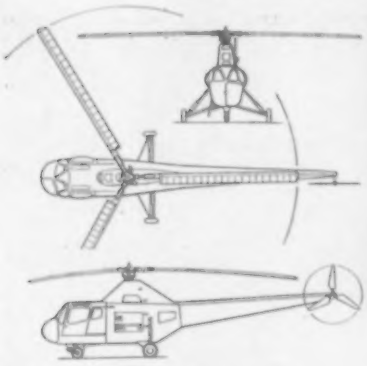
A surprise at the S.B.A.C. Display this year was the demonstration by a Skeeter fitted with rocket boost in the form of Napier tip-thrust units. The fuel, which is high-test peroxide, is carried in a tank mounted above the rotor hub, and is pumped through the blades to the rocket units by centrifugal action. On entering the tip unit the liquid H.T.P. is decomposed into superheated steam and oxygen by means of a catalyst. The generated gases then pass to a nozzle at the tip of each rotor blade, through which the H.T.P. steam is ejected at high velocity to provide the thrust reaction. Over 100 test runs in some ten hours' flying had been made by the time the machine was demonstrated at Farnborough. Weight of the total installation is less than 30 lb (plus 90 lb of H.T.P., giving a duration of about 2½ min), and the thrust from each unit is 22 lb. The vertical rate of climb of the Skeeter 6, it is claimed, is increased to 1,400ft/min by the tip units, and the sea-level rate of climb from 1,020ft/min to 1,800ft/min (I.C.A.N. conditions, identical payloads and piston-engine fuel weights).

● Rotor diam., 32ft; fuselage length, 28ft 5in; gross weight, 2,150 lb; max. speed at s.l., 100 m.p.h.; rate of climb at s.l., 1,020ft/min; vertical rate of climb at s.l., 230ft/min; hovering ceiling (free air), 1,100ft; min. rate of descent (engine off), 1,350ft/min.





A Saunders-Roe Skeeter demonstrating its ability to operate from an Army vehicle.



(Left and above) Westland Widgeon—recent subject of a "Flight" air test (October 12).

Helicopters of the World . . .

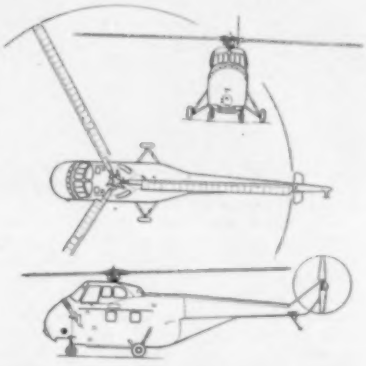
WESTLAND AIRCRAFT, LTD.

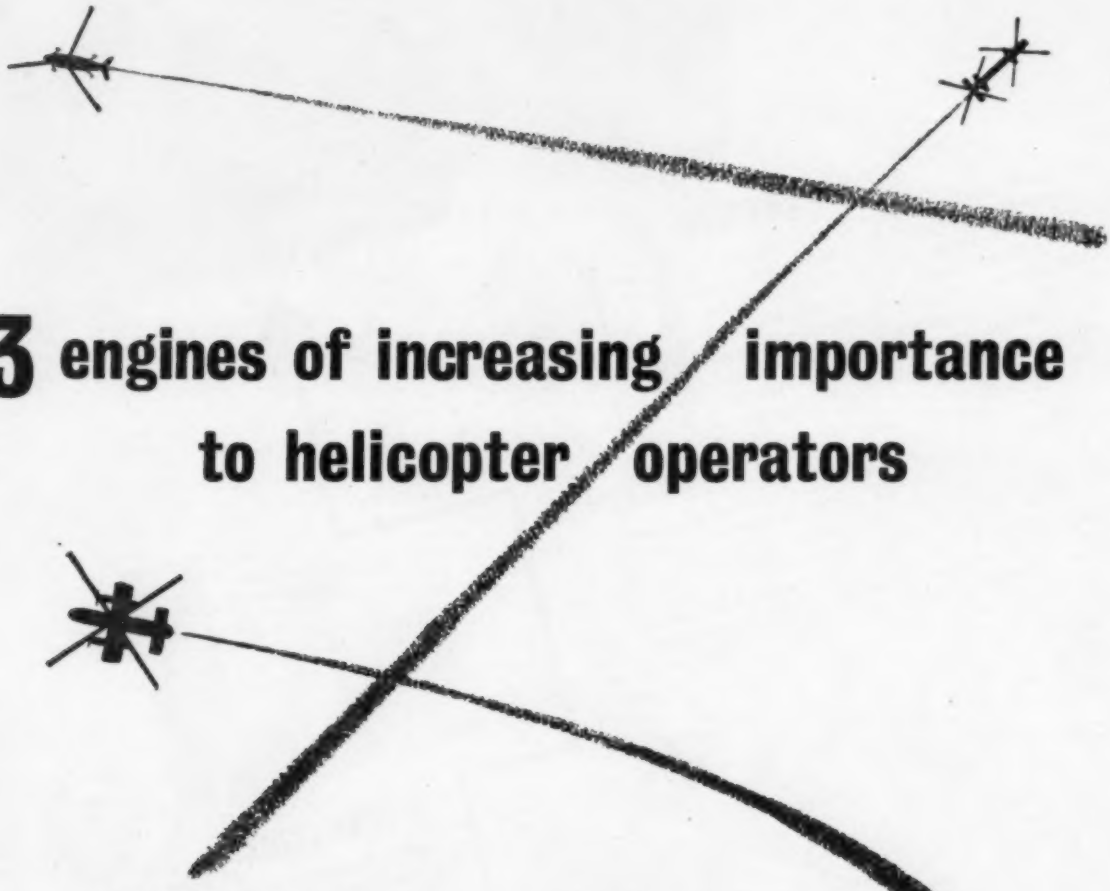
Yeovil, Somerset.
(Yeovil 1100)

Widgeon In dealing with this promising new helicopter we can do no better than quote from the Editor's impressions, entitled "Widgeon in the Air," printed in our issue of October 12. "One does not need to look hard," he remarks, "to see that the Widgeon has many features in common with the familiar Dragonfly. It has the same central body and tail; the Alvis engine, undercarriage and tail rotor are unchanged, and the pylon supporting the rotor head is almost identical. There the similarity stops, for the head and blades are those of the larger Whirlwind, the blade span being cropped to suit the Widgeon. The cabin is much redesigned to give side-by-side seating—with dual control if needed—in front, and a comfortable, three-abreast bench behind. Ambulance and other layouts are also possible. The flying controls, like those on the later Dragonflies and the Whirlwinds, are hydraulic servo-assisted, and, together with the Whirlwind head, they provide a marked increase in stability. The Dragonfly's sensitivity over c.g. position has gone, and with it the need to add ballast in the nose or elsewhere, according to load.

"The big differences in flying the Widgeon," ran the report, "seemed to me to be in its stability and the feel of its cyclic-pitch lever. The stick produces the expected results without delay and it is extremely light and sensitive to use. There is scarcely any relationship between the way it now functions and the way its counterpart worked on G-ALIK in early

(Below) Westland Whirlwind.





3 engines of increasing importance to helicopter operators

ELAND Fairey's new large transport helicopter, the Rotodyne, is to be powered by two *Elands*—basically similar to the standard *Eland*, but with an auxiliary compressor mounted co-axially at the rear. Power is taken through the auxiliary compressor (in the form of compressed air to the rotor) for vertical flight, and through the propeller for forward flight.

ORYX The Napier *Oryx* 780-950 gas h.p. turbo-gas-generator provides the hot gas which is ducted to the rotor head for the propulsion of helicopters by jet reaction at the rotor blade tips. This system eliminates all mechanical transmission. The *Oryx* has been officially Type Tested at 780 and 865 gas h.p.

GAZELLE *Gazelle* 1260-2000 s.h.p. A rugged new free turbine engine for helicopters—selected for the Royal Navy Westland "Wessex" and the R.A.F. twin-rotor Bristol 192. For ease of installation it can be mounted in any position between the vertical and horizontal. Helicopters demand tough, reliable engines—the *Gazelle* is designed for strenuous duty, long service between overhauls, while its outstanding simplicity means economical and speedy maintenance.

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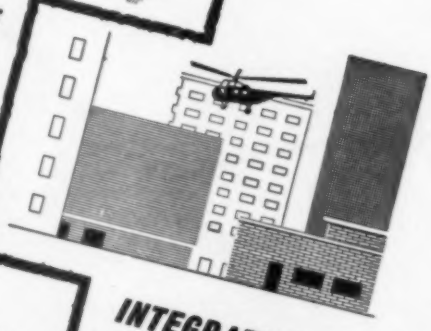
SEPARATION

Decca's accuracy and coverage at all altitudes permits close lateral track separation of all aircraft. A recent M.T.C.A. Notam proposes "to take advantage of the high accuracy of the Decca Navigator System to introduce procedures in the London Flight Information Region which will expedite traffic by employing reduced separation standards."

COVERAGE

With solid cover at low altitudes Decca suits the helicopter "down to the ground". Unaffected by altitude, terrain, weather or the limitations of line of sight systems, the Decca Navigator System can be used to navigate with the greatest accuracy from city centre to city centre. Over some million square miles in Europe the system is sufficiently accurate to be used as an approach aid.



INTEGRATION

Decca, the only system available to every type of aircraft both rotary and fixed-wing, irrespective of altitude, ensures the maximum utilisation of available air space by providing solid cover at all altitudes. Light and compact enough to be fitted in the smallest aircraft. The pictorial presentation of the flight log allows existing air traffic control procedures to be carried out with great accuracy and ease.

FLEXIBILITY

This area coverage system allows any predetermined track to be maintained precisely. The flight log gives a continuous display of the aircraft's position at all times thus allowing complete flexibility of routing.

THE DECCA NAVIGATOR

THE WORLD'S MOST ACCURATE NAVIGATION SYSTEM

THE DECCA NAVIGATOR COMPANY LTD.
LONDON, ENGLAND

Helicopters of the World . . .

(Above and right) Westland Wessex.

manual-control form. If the servo-control selector is switched off, the pilot receives a quick reminder of how the original Dragonfly controls felt. As for stability, the one-armed paper-hanger technique has given way to a placid guidance with the collective pitch control, friction-locked for much of the time. A pilot on cross-country can now fold his map, scratch his nose or play with the instruments without fear of lurching off course and altitude.

"The collective pitch lever is not quite so different as the cyclic one; it resembles quite closely that on a Whirlwind, as could be expected in view of the rotor head similarity. But by comparison, again, with the Dragonfly it has been much tidied up, has a more convenient, short movement, is much lighter to operate—though not too sensitive—and is very nicely co-ordinated with control of engine power."

• Rotor diam., 49ft 2in; fuselage length, 41ft 3in; weight empty, 4,378 lb; gross weight, 5,900 lb; cruising speed at s.l., 80 m.p.h.; max. permissible speed at s.l., 104 m.p.h.; rate of climb at s.l., 1,190ft/min; ceiling, 12,800 ft.

Dragonfly Production of the Dragonfly general-purpose civil/military helicopter (Pratt and Whitney Wasp Junior or Alvis Leonides engine) is now practically complete, the type having been succeeded in the Westland line by the Widgeon.

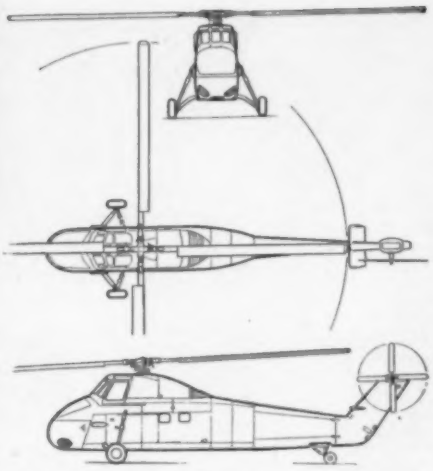
Whirlwind The latest basic model of the Whirlwind is the Mk 5, powered with the Alvis Leonides Major engine. A complete engine-change unit enables the American Wasps and Cyclones of earlier Whirlwinds to be easily replaced in future by the British engine, which is intended to become standard. Of the Leonides Major's 900 available horse-power only 750 is normally used at sea level, and of this some 60 h.p. is used to drive the cooling fan. Maximum power is maintained up to 4,000ft under standard conditions and the power benefit is, of course, available for operations in tropical climates. The engine is installed in the extreme nose behind two clamshell doors and a simple operation enables it to be swivelled forwards and downwards to give ready access for servicing. The four-blade main rotor is of all-metal construction and the makers claim it to be completely immune to temperature and humidity effects. The blades are matched with a master blade and are individually interchangeable.

Seen at the S.B.A.C. Display this year was the new drooped tail cone, already introduced in military Whirlwinds and soon to be standardized in civil versions. In the original design the Whirlwind's tail cone was parallel to the ground and the droop has been introduced to give more clearance between the main and tail rotor blades when the helicopter is landing under difficulties, such as in gusty conditions on the deck of an aircraft carrier, or in an autorotative landing. The modification has involved the addition of a spring-loaded tail skid and the repositioning of the stabilizers, so that they are now parallel to the ground. The tail-rotor pylon has also been redesigned.

The Whirlwind has accommodation for a pilot and observer or co-pilot and up to eight passengers, with luggage. Available space is easily adaptable for freight-carrying, for rescue operations, ambulance work (with six stretchers and medical attendants), or other specialized rôle. When a winch is required it is fitted on the starboard side above the main cabin door, and the pilot has an excellent field of view for winching operations.

• Rotor diam., 53ft; fuselage length, 41ft 8in; gross weight, 8,000 lb; max. permissible speed at s.l., 109 m.p.h.; normal cruising speed at s.l., 86 m.p.h.; sea level rate of climb at "1 hr" power, 825ft/min; service ceiling, 12,500ft; hovering ceiling (10ft wheel clearance), 7,000ft; max. range with standard tankage (no allowances), 345 miles. Data are for Whirlwind Mk 5.

Wessex This completely re-engineered development of the American Sikorsky S-58 is scheduled to go into service with the Fleet Air Arm and with other branches of the Services—and possibly with civil operators also—in 1958. Powered with a Napier Gazelle gas turbine, it will have an excellent performance, as shown in Col. 3. The naval version will be suitable for anti-submarine work, search and rescue, communications and supply, casualty evacuation and training. In the anti-submarine rôle it will carry "special equipment and strike weapons"; alternatively, in addition to a crew of two, accommodation can be provided for twelve passengers and baggage, or for eight stretcher cases. The four-blade main and tail rotors both have all-metal, fully interchangeable blades with a symmetrical aerofoil section and freedom of movement in both vertical and horizontal axes. Control is hydraulic servo-assisted. The undercarriage is unusual in having a tailwheel well back along the tail, the final portion of which can itself be folded for carrier stowage.

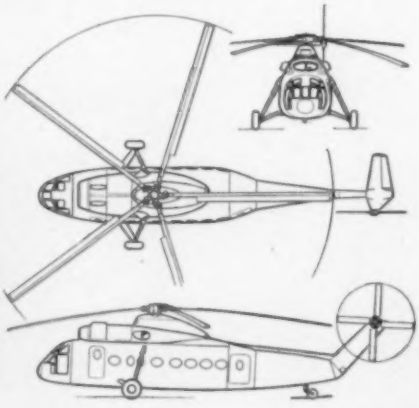


• Overall length, 65ft 9in; weight empty, 7,259 lb; normal gross weight, 12,600 lb; max. speed at s.l., over 132 m.p.h.; cruising speed at s.l., over 126 m.p.h.; max. rate of climb at s.l., 1,350ft/min; hovering ceiling in free air, 4,500ft; hovering ceiling with ground effect, 8,400ft; range with normal fuel, 440 miles; ceiling (cruising), 6,000ft.

Westminster It was announced recently that preliminary work on the massive Westminster had made good progress during the past few months. The first flight-prototype will be a simplified "crane." Two Napier Eland gas turbines are specified and the ultimate version will seat forty passengers or carry thirty-two stretcher cases. The layout of the aircraft—featuring a single main rotor driven by the twin turbines mounted on top of the fuselage—was evolved by Westland designers "to take full advantage of the compact nature of British rear-drive gas turbines and to give maximum hovering performance."

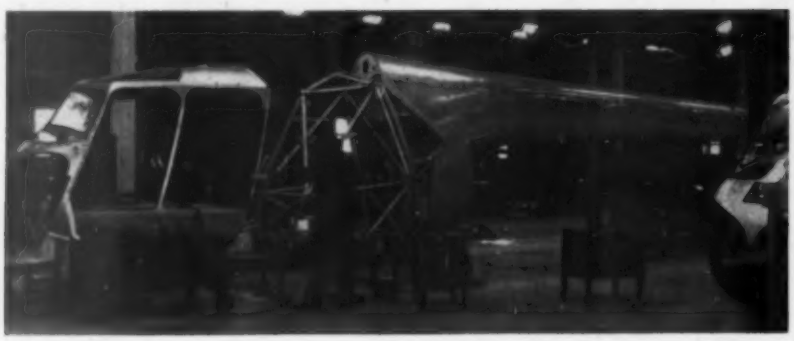
• Gross weight, 33,000 lb; disposable load, 13,000 lb; range at 149 m.p.h., 355 miles.

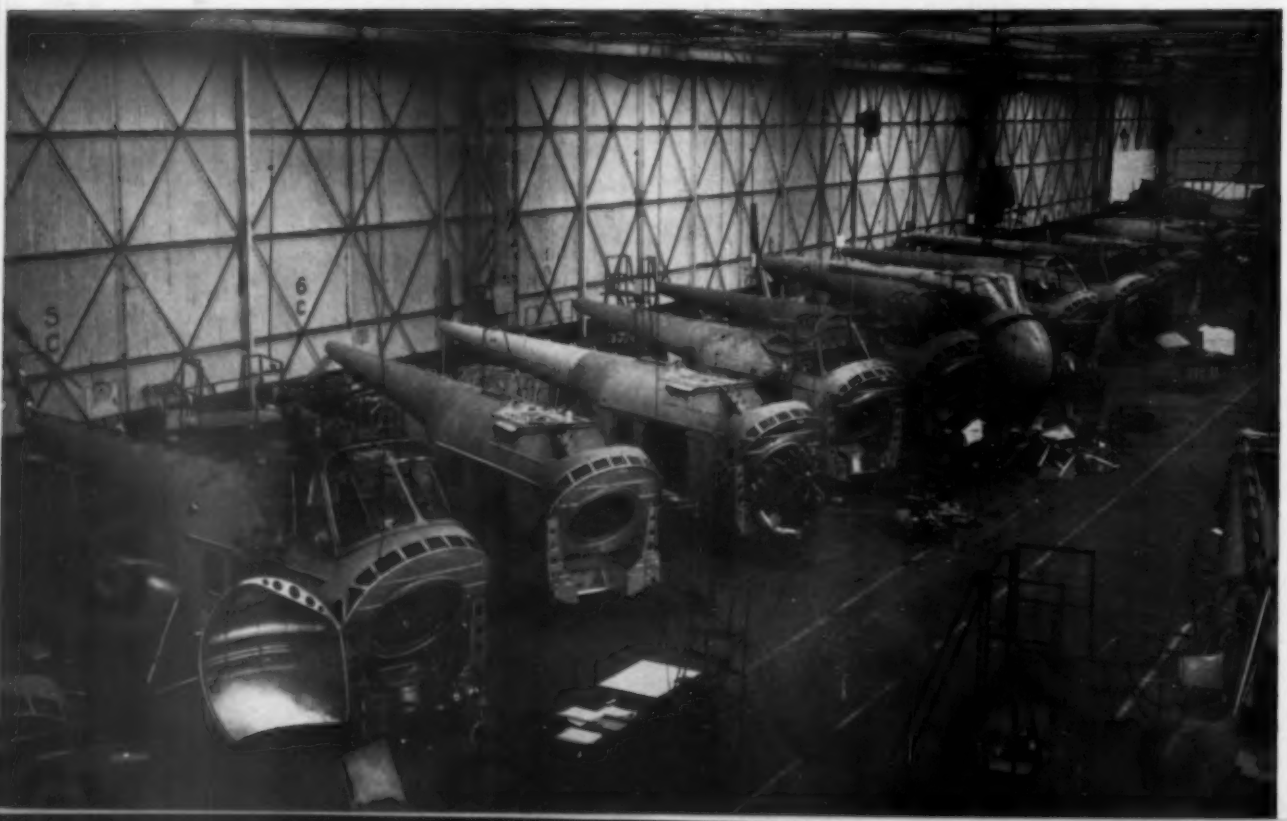
(Below and right) Westland Westminster.



British Helicopter Production

AFTER the move of Bristol helicopter activities from Filton to Weston-super-Mare, production of the Sycamore is now in full swing. By the end of this year the Weston factory will have produced 20 of these machines and will thereafter be maintaining full production. On the left is a general view of the Sycamore production hangar and, below it, a glimpse of Sycamore assembly. The front and intermediate sections of fuselage are being joined by the tubular basket structure in which the Alvis Leonides engine is placed. As for Westland activities, the third picture, showing Whirlwind production at Yeovil, is eloquent. To meet their rapidly expanding programme Westland Aircraft, Ltd., have considerably extended and improved their works. A new block has been built to house the technical and drawing offices, and a fine new machine shop has been laid out.





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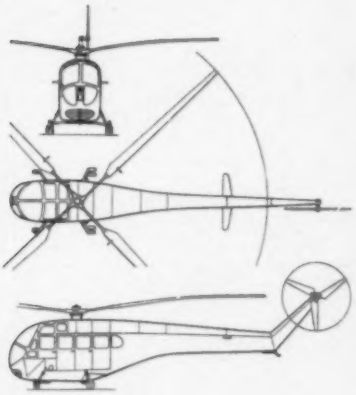

Helicopters of the World . . .

(Above and left) Doman-Fleet LZ5-2.

CANADA

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(Fort Erie 1400)

LZ5-2 The LZ5-2 helicopter is described at some length under "U.S.A." (Doman). The same aircraft is now going into production in Canada, at the Doman-Fleet factory, with a view to capturing the promising Canadian commercial market for helicopters, as well as R.C.A.F. and R.C.N. orders which are understood to be in prospect. A Canadian C. of A. was granted for the Canadian-built demonstration model in May this year. Doman-Fleet are now working on the adaptation of the Lear Nafli instrument system for use in the LZ5-2, the object being to obtain fixed-wing standards of IFR flying. The demonstrator is being fitted with complete airline-type equipment, including ILS, ADF, Lear Arcon rudder control, engine-speed governor, etc., prior to demonstration before the U.S. Army. Ultimately the company hope to obtain from the Canadian Government either a certificate to the effect that the LZ5-2 can be flown commercially on instruments, or a conditional removal of IFR limits.

● Data as for Doman LZ5-2 (page 724).

U.S.A.

BELL AIRCRAFT CORPORATION

Helicopter Division, Fort Worth, Texas.
(Atlas 4-3434)

Model 47G Operated by the U.S.A.F. under the basic designation H-13 and by the U.S. Navy as the HTL, the Model 47G is a widely used multi-purpose helicopter. A characteristic feature is the bubble-type cabin of blown Plexiglas, which combines an excellent field of view with good optical qualities. The three occupants are seated abreast, and there is an aluminium-framed Plexiglas door, containing two ventilators, on each side. The fuselage is a light open structure of welded steel tubing. The engine, a six-cylinder Franklin 6V4-200-C32, drives both the main and tail rotor, generator and cooling fan through a two-stage planetary transmission. The reduction ratio of engine speed to the main rotor is 9:1. The two blades of the main rotor are of laminated wood and the rotor assembly incorporates a steel stabilizer bar. A feature introduced on the "G" version of the Model 47 is a synchronized elevator tied directly into the control system to provide more stability and allow a greatly increased c.g. travel. The twin undercarriage-skids are of aluminium alloy, and ground-handling wheels and mooring and towing attachments are standard. An alternative fitment is a quick-change flotation gear in the form of twin pontoons, which convert the Model 47G into a very effective machine for all types of amphibious operation—especially from marsh and swampland. Kits can be supplied to equip the machine with rescue litters, two types of external cargo carriers, VHF multi-channel radio, or spraying, dusting or fogging equipment.

● Rotor diam., 35ft 1in; overall length, 41ft 2in; weight empty, 1,435 lb; gross weight, 2,350 lb; max. speed, 90 m.p.h.; cruising speed, 77 m.p.h.; rate of climb at s.l., 800ft/min; time to 5,000ft, 8 min; service ceiling, 10,900ft; hovering ceiling in ground effect, 3,600ft; range, 215 miles. (Performance figures are for maximum permissible weight of 2,350 lb.)

(Right) Bell Model 47G.

(Lower right) Bell Model 47H.

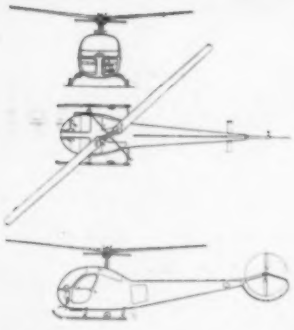
Model 47G-2 This version of the Model 47 has a Lycoming VO-435 engine but is otherwise similar to the standard 47G.

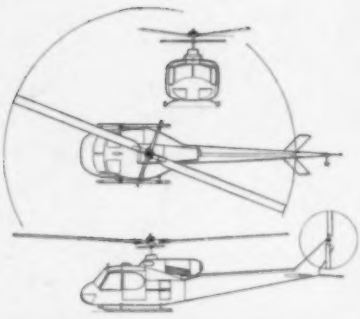
XH-13F An experimental version of the 47G, having a 280 h.p. Continental XT51-T-3 (Turboméca Artouste) shaft-drive turbine.

Model 47H In effect a "streamlined" version has a metal monocoque tail boom containing a luggage compartment large enough to carry baggage for all three occupants. The width of the cabin interior has been increased to 60in, permitting the use of car-type seats, and noise level has been much reduced. Fiberglas is used for some cabin sections and door assemblies.

● Rotor diam., 35ft 1in; overall length, 41ft 2in; empty weight, 1,502 lb; gross weight, 2,350 lb; max. speed at s.l., 102 m.p.h.; hovering ceiling in ground effect, 9,900ft; range, 219 miles.

Model 47J Ranger This is a four-seater development of the Model 47 and has been ordered by the U.S. Navy under the designation HUL. The bubble-type cabin provides for a pilot seated forward and three passengers abreast behind him. All instruments and controls are arranged to the left of the pilot to allow maximum visibility. The fuselage houses baggage for all four occupants. As an executive aircraft the Ranger is being made available with either a standard or custom interior. In ambulance service a complete stretcher kit for two patients can be installed in five minutes. A quickly removable floor section enables an electric hoist to lift objects





Helicopters of the World . . .

(Above) Bell Model 47J. (Right and below) Bell Model 212 (XH-40).

directly into the cabin. The engine is the Lycoming VO-435-21. First deliveries are to be made early in 1957.

● Rotor diam., 37ft 2in; overall length, 43ft 4in; weight empty, 1,510 lb; gross weight, 2,565 lb; max. speed at s.l., 108 m.p.h.; service ceiling, 15,000ft; climb to 5,000ft, 7.5 min; absolute ceiling, over 16,000ft.

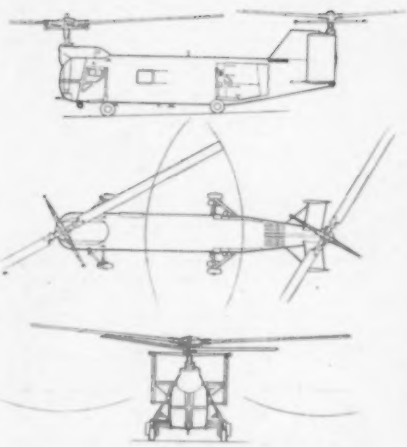
Model 212 Bearing the Service designation XH-40, this helicopter is the outcome of a 1955 competition held by the U.S. Army. Said by the makers to be "capable of matching the climbing performance of World War 2 fighters and the speed of many of today's light airplanes," it will be a six-seater, incorporating many new features. For instance, it will be the first helicopter to provide in-flight blade-tracking. The blades themselves will be of all-metal construction and the rotor hub of new design. A Lycoming XT-53 gas turbine is fitted, and Bell engineers predict that the aircraft will be the first to achieve a thousand-hour flight period between overhauls (the corresponding period for the Model 47G is 600 hr). Permanent maintenance platforms are being provided, and there is a built-in hub wrench. Provision is being made for IFR flying.

The following extract from a makers' announcement is of particular interest: "The XT-53 boasts low fuel consumption, minimum size and weight, maximum utility, flexibility and maintenance practicability. The free-power principle does away with the need for a clutch and turbine engines eliminate fans, spark plugs and reciprocating parts, for an appreciable maintenance saving. Another advantage is that a wide range of fuel (JP-4, all-purpose automotive, aviation fuel, even kerosine) can be used. Spark plug fouling, a common problem in Korea, where proper high octane fuel was not always available, does not exist. Translated into performance, Bell engineers anticipate an empty weight reduction of 35 per cent, a 100 per cent increase in payload, and a 43 per cent increase in cruise speed for the turbine-powered XH-40 compared to similar reciprocating engine-driven utility helicopters in use today."

● Rotor diam., 44ft; overall length, 57ft; weight empty, 3,344 lb; max. weight, 5,619 lb; max. speed, 152 m.p.h.; vertical rate of climb, 1,900ft/min; hovering ceiling in ground effect, 19,000ft; range, over 200 miles.

Model 61 This twin-rotor helicopter (U.S. Navy HSL-1) was the first machine of its class designed specifically for anti-submarine warfare. Although prototypes were flying in 1953, HSL-1s are still not operational, and it has been reported that necessary modifications include a new rotor of larger diameter. The Pratt and Whitney R-2800 piston engine is installed aft on a hinged mounting and the twin rotors are arranged to fold for carrier stowage. In the original design provision was made for anti-submarine equipment and

(*Review continued on page* 721)



(Right and below) Bell Model 61 (HSL-1).

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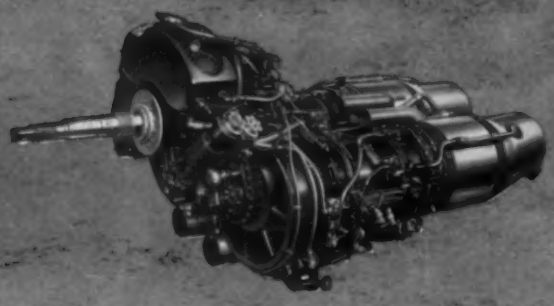

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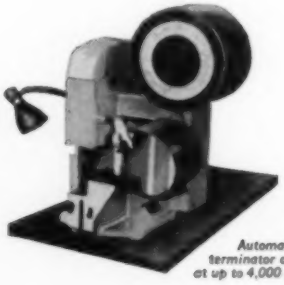

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Ahead of the present — *— abreast of the future*

AP323-14

this helicopter age . . .

THE VALUE of the helicopter as a short-haul vehicle capable of operating without runways was first clearly shown in military operations in Korea and Malaya. Since then there have been developments in both civil and military spheres that promise to transform communications and transport in the near future.

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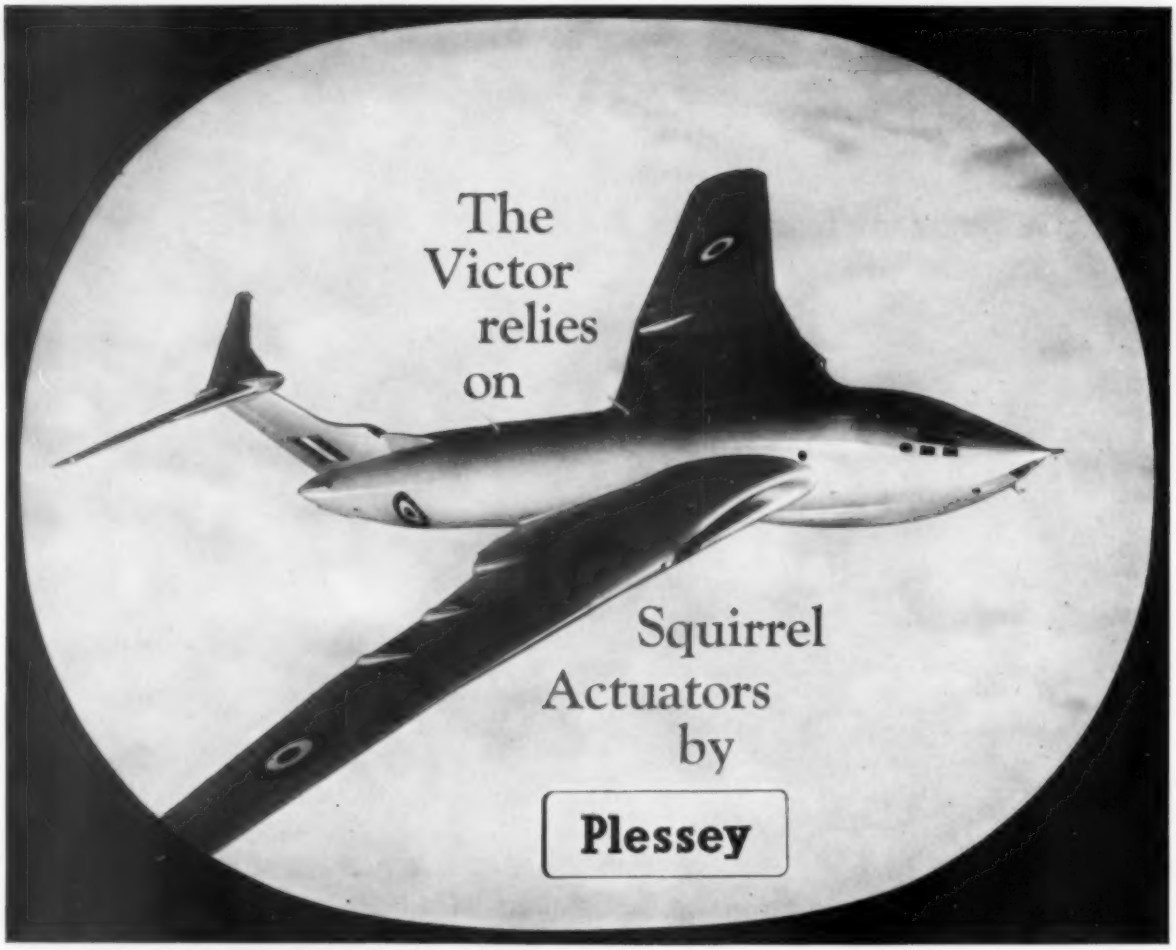

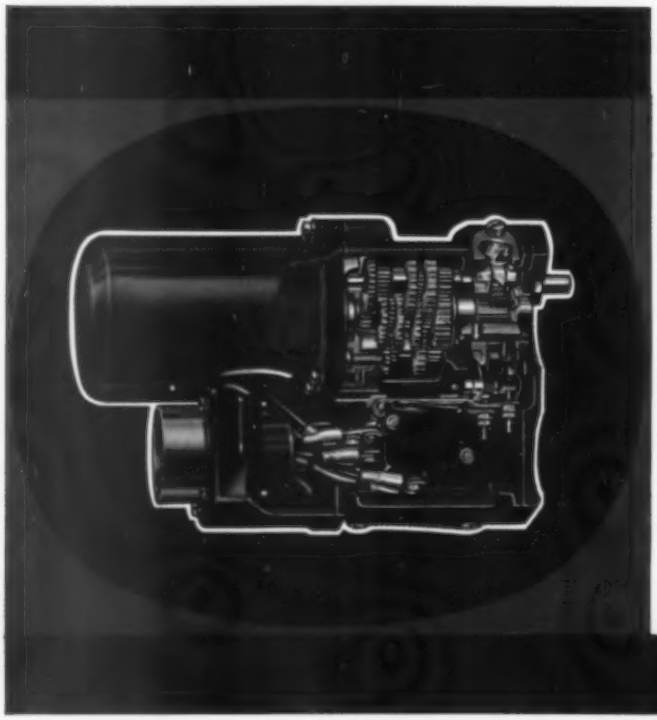

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A72

Helicopters in peace: Sabena, with their Sikorsky S-55 inter-city services, are accumulating "sufficient goodwill and experience to give them an unassailable lead over their competitors."

Has the helicopter fulfilled its early promise? Are designers and constructors working on the wisest lines? These and other pertinent questions are discussed in this critical article, which goes on to re-review the numerous applications and possibilities of rotating-wing aircraft in war and peace

By JOHN W. R. TAYLOR

HOW FARES THE HELICOPTER?

IT is now 13½ years since glowing technicolored magazine stories about Igor Sikorsky's pioneer VS-300 helicopter began to predict that we should all one day find ourselves hopping happily around the countryside in rotating-wing "family cars" and airbuses.

To the credit of Press, P.R.O.s and public alike, interest has seldom flagged. Questions on helicopter progress, or lack of it, have appeared by the dozen on the Order Paper in the House of Commons: some have even been answered. The War Office has examined the usefulness of helicopters; the Ministry of Supply has given spasmodic encouragement to our helicopter-builders. The possibility of inter-city passenger services in this country by 1960 has been hinted at many times.

In fact, if the skies over England were as full of helicopters as are the pages of our newspapers and magazines we could all feel very pleased with ourselves. But they are not; and it looks very like a case of no jam today, or tomorrow, or the next day, but perhaps one day, *if* . . .

To a certain extent some of the "ifs" are justified. Mechanically and aerodynamically, many helicopters still leave much to be desired. Back in 1943, Sikorsky is reported to have said "Flying the helicopter is like dreaming. It performs without effort. You wish to go thither and it goes thither. Likewise hither, and also yon." Yet, in the recently published *Aircraft Annual*, one of our best-known young helicopter pilots comments that, in 1956, "Learning to fly a helicopter is no more difficult than riding a one-wheeled bicycle. All you need is the co-ordination of a circus juggler, the wrist-muscles of a strong-arm man and the income of a barrow-boy."

Helicopter progress has been disappointingly slow; and to plead that aeroplanes made no greater progress in their first 13 years is a feeble excuse, because helicopter engineers have at their disposal all the experience and technical developments of 50 years of powered flight, as well as considerable assistance from the automotive industry in such matters as transmission design.

By 1916, thirteen years after the first flight by the Wright brothers, the tractor biplane configuration had been accepted by most aircraft designers throughout the world, and there was a steady improvement in performance and efficiency without any revolutionary change in configuration until the monoplane returned to favour.

A glance through this issue of *Flight* will show how little standardization of layout has been achieved in the helicopter field in a similar period of time. The "conventional" single-main-rotor-plus-tail-rotor configuration has, admittedly, been adopted by many of the most successful manufacturers, and its essential simplicity probably explains why they are successful. For the rest, there is a hotch-potch of tandem, intermeshing, tilting and co-axial rotors, mixed in with "flying platforms" and a variety of different power systems. One is left with a feeling that too many of the helicopter boys are theorists whose aim is to test a constant succession of bright new ideas rather than to try and get helicopters into production and service. For this reason, even if one disagrees in part with the choice of types and deplores parsimonious penny-counting, there is little doubt that the

Helicopters in war: "Even the smallish H-19 or HRS (U.S. Service designations of the S-55) . . . can airlift a field gun or rocket mortar and crew to front line positions . . ." This photograph of an airlifted rocket battery in action was taken during the Korean war.

HOW FARES THE HELICOPTER? . . .

Among the helicopter's diverse naval duties are minesweeping, and this demonstration by a Bell HSL-1—it is towing a dredger—was to show its power for such work. (Below) Dragonflies of the Royal Navy have effected numerous rescues from water, many with the aid of the Sproule scoop-net. (Bottom) Casualty evacuation by S-55 during the recent war in Viet-Nam.

Ministry of Supply is right in restricting severely the number of helicopter projects to which it gives official support.

Apart from apathy on the part of potential operators and an overdose of dabbling by designers, the enemies of helicopter progress are complexity, cost, control problems and the lack of facilities for safe night and all-weather operation. To a certain extent, these are interdependent, because cost goes hand-in-hand with complexity; and when helicopters are easier to fly their pilots will have fewer worries when flying blind.

Progress would be quicker if there were more co-operation and study of basic problems within the industry. It is difficult to see why there is no general agreement on the superiority of the single-rotor configuration, which seems as inevitable in the long run as the monoplane, for much the same reasons of simplicity and aerodynamic efficiency. It is significant that Sikorsky has never been tempted away from it and that most of the companies which have aimed at a better range of c.g. travel by using tandem rotors have encountered vibration troubles resulting from interference between the rotors and backlash in lengthy transmission shafts.

Hiller is another company that has retained its faith in a single main rotor, and its engineers made a major contribution to progress in 1949 when they completed a study to determine ways of reducing the high cost of helicopters. This showed that complexity and high cost stemmed mainly from the transmission and torque-compensating systems and all the intricate mechanisms of the piston-engine. The answer, which had been foreshadowed by the wartime Doblhoff designs, was rotor-tip propulsion, requiring no torque compensation, and there is a slow but steady swing towards this technique, with competition coming mainly from direct-drive systems using a simple shaft-turbine.

Following their study, Hiller began developing pulsejet engines, which offered a fuel consumption of around 7 lb per hour per pound of static thrust, but abandoned them in favour of the simpler ramjet, although this increased consumption to about 12 lb/hr/lb. McDonnell in America and Fairey in England have, on the other hand, gone for the pressure-jet, which involves provision of a compressed air system but offers a consumption of only 2 lb/hr/lb.

A practicable alternative for ultra-light helicopters is the system used on the French Djinn, in which the rotor is turned simply by compressed air ejected from the tips without burning. At the other end of the scale, the ultimate form of power for a very large helicopter would seem to be tip-mounted turbojets, with a consumption of under 1 lb/hr/lb. The advent of engines like the Soar, with high power : weight ratio, will make this possible, although the gyroscopic effect will present some design problems.

From all this, it is apparent that Britain has potentially the most advanced and promising helicopter in the world in the Fairey Rotodyne, with its single main rotor driven by tip pressure-jets, and two Eland turboprops for fast cruising flight. Performance estimates published in *Flight* on August 17 showed that this 40-50 seat aircraft offers direct operating costs that bear no relationship to those of other helicopters, being lower even than those of modern fixed-wing airliners. Over a stage-length of 100 miles the Rotodyne is estimated to cost 2.8d per seat statute-mile, compared with 17d for a good single-rotor helicopter of the present time and 14d for a larger, twin-rotor machine. For a 300-mile stage-length, the figures are even more favourable to the Rotodyne.

These estimated costs have been published only after careful model tests and a great deal of flying by the Gyrodyne research helicopter, which has a basic Rotodyne rotor system. Nor do Faireys expect the interference troubles experienced with the Sikorsky S-56, which is a stub-winged helicopter of somewhat similar size, because the fuselage and wings of the American aircraft present a much greater obstruction in relation to disc area than do those of the Rotodyne.

The use of fixed wings and normal forward-facing turboprops, as in the Rotodyne, is not the panacea for all helicopter operations. Wings would be a disadvantage on an anti-submarine helicopter, which needs every scrap of lift it can get whilst hovering with its dipping sonar detection gear in use. Wings would reduce lift by about 7 per cent and offer in exchange only unwanted forward speed.

(Above) Helicopters of the R.C.A.F. have proved indispensable in the construction of the vast new radar chains in the Far North. (Right) A Bristol Sycamore performs a "crane" operation during the erection of an off-shore navigation beacon.

There is, therefore, a future for the normal pure helicopter.

Nor, according to the experts, have helicopters much to fear from the new generation of V.T.O. (vertical take-off) and S.T.O.L. (short take-off and landing) aircraft. The pioneers of direct jet lift foresee no commercial application of the idea during the next ten to fifteen years, mainly because of the noise problem. Other designers go even further, doubting if direct jet lift will ever be used except as an assisted-take-off technique, because its efficiency is low and its fuel consumption astronomical. The "flying platform" idea represented by Hiller's unique ducted-fan prototype finds equally little favour, largely by reason of the fact that its inherent safety-factor is low. Certainly in the event of engine failure there is no possibility of making an auto-rotative descent, which puts a severe limitation on the height to which most people would be prepared to take it.

S.T.O.L. aircraft, whether using boundary-layer control, extensive flaps, jet flaps, large-diameter propellers, jet deflection or other devices, are regarded as complementary to helicopters. If they could operate from 300-ft strips with heavy payloads, they would begin to be competitive, but the majority belief is that all types of V.T.O. and S.T.O.L. aircraft must pay rather severe payload restrictions.

They are glamorous (if the word may be forgiven), fast and of definite value in certain specialized instances, such as for target defence in a short-range intercepter rôle; but there seems little doubt that the helicopter will remain a day-to-day workhorse, performing routine jobs throughout the world. The payload of the large helicopter is fast becoming significant and as a short-range (up to 400 miles) multi-passenger vehicle, cargo-carrier, and military assault transport, it should remain pretty much unbeatable—*if it is given the chance.*

At the moment, helicopters are used mainly for work that could be done by no other vehicle, so that their high initial and operating costs are immaterial. Typical of such jobs in recent years have been casualty evacuation in the jungles of Malaya, landing troops on inaccessible mountain positions in Korea and rescuing marooned civilians from the roofs of half-submerged houses during floods in the Netherlands, America and elsewhere. In addition, there are a number of tasks in which, despite their cost, helicopters are still cheaper than other vehicles. An example here is the replacement of destroyers by helicopters for 'plane-guard duties during deck operations from aircraft carriers.

For more general transport duties the current helicopter is out of the question economically. Yet this does not prevent Sabena from operating their pioneer international network of routes on the Continent. They realize that, one day, aircraft like the Rotodyne will change the whole picture and, when that time comes, they will have sufficient goodwill and experience to give them an unassailable lead over their competitors. In short, they have courage and commonsense of the kind that is essential if the helicopter is ever to give us the service of which it is capable.

* * *

As in most spheres of aviation, the helicopter lead must come from the fighting Services, to underwrite the high design and development costs. This is particularly unfortunate in the case of Britain, where the Army's air transport ideas are dominated by the Royal Air Force, whose budget is already too small to provide as many first-line fighters and bombers as it needs.

Fortunately the Royal Navy has shown more initiative. Just as, in the early days, it put the struggling British aircraft industry on its feet at a time when the War Office preferred standardized State-produced fighting aircraft, so it has given our helicopter industry a great deal of encouragement since the war. When helicopters were first needed urgently in Malaya, only the Navy could fill the breach. Fleet Air Arm Whirlwinds soon achieved a fine reputation on transport, supply and casualty evacuation missions. At sea, in addition to 'plane-guard and liaison duties, helicopters are in service or under development for anti-submarine search and strike, with radar, dipping sonar, sono-buoys, depth charges and rockets, and for minesweeping, where they are unlikely to run the same risk of being blown up by an exploding mine as does a surface minesweeper.

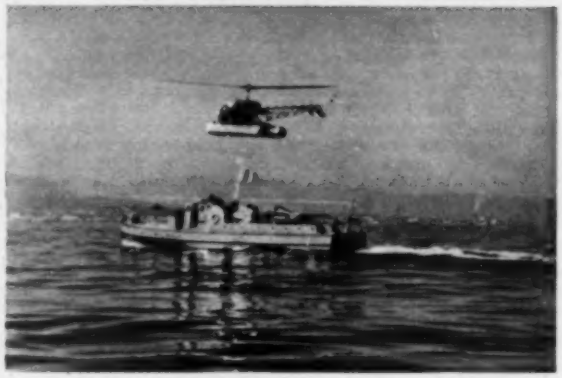
The R.A.F. has its Sycamore and Whirlwind rescue helicopters. In Malaya, No. 155 Squadron carried 25,802 troops, 1,694 other passengers, 40 tracker dogs, nearly 400,000 lb of urgent freight and one small elephant in its first two years of service on anti-terrorist operations. In addition, the Army has at least ordered a sizeable number of Skeeters to supplement its Austers for A.O.P. duty. These are steps in the right direction: but much more is needed.

In the Army's defence, it must be admitted that its vaster, wealthier U.S. counterpart has not pressed ahead in equipping its transport companies with helicopters with the enthusiasm it displayed in 1953, when plans were made to procure sufficient helicopters to equip 12 battalions with 67 aircraft per battalion. High maintenance costs, the small single-lift capacity of current types, the vibration troubles experienced with the tandem-rotor Work Horse and the slow development of the S-56 have undoubtedly contributed to this slow-down; and the greatest blow of all must have been the decision to abandon the 40-seat Vertol H-16 Transporter. It means that only the Soviet Army now has helicopters of this class in service.

There is no way of telling what standards of efficiency, reliability and comfort are offered by the big twin-engined Russian Yak-24, apart from the fact that one of these aircraft has set up international helicopter records by carrying a payload of 4,000 kg (8,819 lb) to a height of 2,000m (6,560ft) and 2,000 kg (4,410 lb) to 5,082m (16,673ft). But there is little doubt that the Russians, like the Americans, appreciate the potential value of helicopter troop transports; and it is significant that Soviet military leaders are reported to have said after the last Aviation Day Display in Moscow that tip-jet propulsion is "inevitable" for both large and small helicopters of the future.

The helicopter's place in atomic-age land warfare is clear and undeniable, because it offers essential mobility over "neutralized" areas and obviates the vulnerable "tail" of army transport and supply trucks. Even the smallish H-19 or HRS (U.S. Service designations of the S-55) can deliver some two tons of payload per hour of operation, and on active service has shown an average availability of 57 per cent and daily flying time of four hours. It can airlift a field gun or rocket mortar and crew to front-line positions irrespective of terrain and evacuate them again if the return fire gets too hot. As it does so, it can lay a field telephone wire to link isolated positions with their H.Q.

Korea proved that predictions of failure of a damaged rotor



(Above, left) One of Okanagan Helicopters' Bell 47Ds, whose share in the constructional work on the British Columbia hydro-electric project is described in the article. (Above, right) Another British Columbia operation: a Sycamore lifts fuel drums for a copper-mine at 6,000 ft above sea level. (Right) Police work: an Agusta-Bell with pontoons, used by Italian currency-control officers.

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were unfounded. Helicopters returned safely with holed blades, and crews had no hesitation in making escorted rescue flights to collect pilots who had forced-landed up to 125 miles behind enemy lines.

New techniques promise to have an even greater influence on the course of land battles. Kaman, for example, are developing a pilotless remote-control helicopter that could be used for battlefield reconnaissance with either ciné or television cameras (see *Flight*, October 19). The same company has a contract to produce a design study for an easy-to-maintain flying crane able to lift large bulk loads over distances of 10 to 100 miles across any kind of obstacle. An indication of the possibilities of such an aircraft were given when the gawky Hughes XH-17 flew at a gross weight of over 20 tons, carrying a radar van under its fuselage.

There is almost certainly a future, also, for a collapsible, lightweight personal helicopter like the Goodyear GA-400, or the Hiller XROE-1 and Gyrodyne XRON-1 rotorcycles now being developed for the U.S. Marines, who have gone in for helicopter transportation in a big way since they proved its value in Korea.

The Marines' latest idea is to use helicopters in conjunction with troop-carrying submarines for surprise assault or reconnaissance operations in enemy territory. They tested the idea in July of this year when eight HRS (S-55) aircraft of HMR-261 and 262, Marine Helicopter Transport Group 26, flew 55 combat-equipped troops to the U.S. submarine *Sea Lion* a short distance offshore. The pilots experienced no difficulty in landing at five-minute intervals on the after casing of *Sea Lion* to transfer the Marines, who spent two weeks aboard the submarine, during which time they practised embarkation and disembarkation and night landings through surf.

Not long ago this would have been considered a stunt; but where helicopters are concerned the stunt of today is often the operational duty of tomorrow. Ten years ago, when we watched the first unprofessional demonstrations of "victims" being hoisted from a rubber dinghy in the middle of a field, it was difficult to foresee the efficient, everyday rescue services of the present time, whereby even a badly wounded or unconscious person can be literally scooped out of the water in a net and carried speedily to safety. Sailors have been hoisted off the decks of vessels that have met their end on the rocks or sand-banks around our coasts. In Korea, more than 23,000 casualties were whisked to hospital, reducing to an unprecedented low percentage the number who died from their wounds.

Nor should we dismiss all the "one-off" jobs as being of no consequence. Why should not a helicopter be used to raise a heavy weathercock to the top of a church spire, or to remove a piece of equipment from a 320ft parachute training tower? In the latter case, at Camp Lejeune, North Carolina, a Kaman HOK-1 did in ten minutes what would normally have taken four men a day and a half to do with block and tackle.

Other jobs in this category have ranged from dropping daymark beacons ashore on inaccessible coastlines in the Arctic, in support of the DEWline radar chain construction project, to lifting a 300-lb sheet of plate glass to the roof of a 23-storey

A Hiller of Fison-Airwork, Ltd., spraying cotton in the Sudan.

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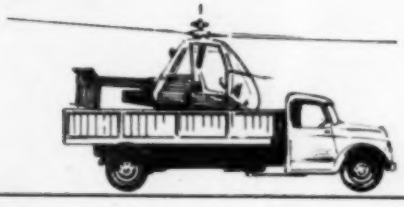

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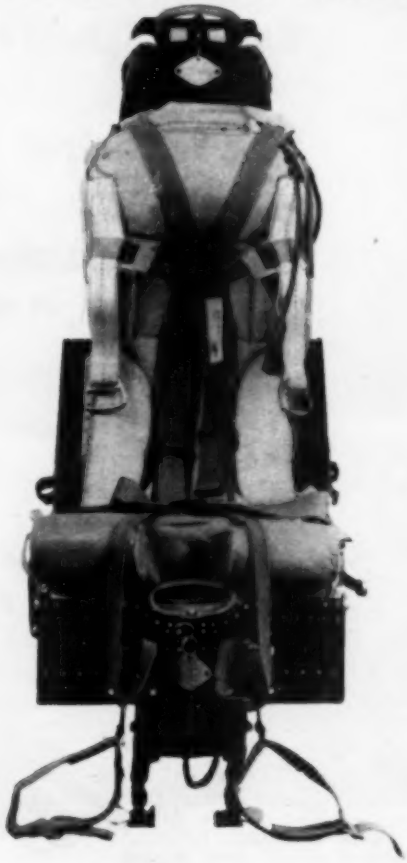

MARTIN-BAKER AIRCRAFT COMPANY LIMITED

ENGLAND —— CANADA

Another scene—and an impressive one—from the British Columbia hydro-electric scheme. It is from sites of this kind that helicopter pilots sometimes have to use the "bump jump" take-off technique described below.

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apartment building in Chicago. Far from being a stunt, this last operation with a Bell 47 avoided the necessity of paying 12 men to erect scaffolding up the side of the building (it had been found that the sheet of glass was too big to go into the interior lift).

It is possible to foresee a considerable demand for this kind of commercial "flying crane" work in the future, because a great deal of money could be saved by using helicopters to lift into position steel constructional girders or bridge sections. Aircraft designed solely for such work would cost considerably less than a normal helicopter, because they would need no cabin or skin structure, and could consist simply of a power-unit and rotor system fitted with a simple undercarriage and a cab for the pilot-operator. They might even be by-products of passenger helicopter design. Westland, for instance, see a possible market as a flying crane for the uncovered-steel-tube "flying bedstead" airframe that they are building to flight test the basic rotor system of their projected 40-passenger twin-Eland-powered Westminster. Such an aircraft could be used to unload ships in places where no dock facilities exist, or where they are so inadequate that ships now have to wait their turn in mid-stream, wasting precious days. Similarly, flying-crane helicopters could take the place of surface transport in undeveloped areas, their cost being insignificant compared with the expense of building roads through deserts, mountains, swamps or forests.

Even the helicopters of today, with their limited payloads, are profitable under such conditions. Typical were the operations flown by Okanagan Helicopters of Vancouver in support of the Aluminum Company of Canada's vast half-billion-dollar hydro-electric power project in the mountains of British Columbia three years ago. Using, in all, five Bell 47s and two S-55s, Okanagan first completed in ten days a survey of the site that would normally have taken three years; achieved a similar time-saving on the triangulation for locating a water tunnel; hauled men and equipment to camps perched on precipitous peaks; and flew to safety five men whose injuries ranged from missing fingers to broken backs. Travelling time for the construction men was cut from 75 per cent of their working week to only 8 per cent, and they arrived at the camps fresh instead of exhausted by a climb of several thousands of feet. Equally important, their morale was high, because they knew that medical care was only a short hop away if they were hurt.

Using "airfields" that consisted at best of a wooden platform 20ft × 16ft made from timber hauled up piece by piece by the helicopters, and at worst a cloth carpet over a flattened mountain ledge, the seven helicopters airlifted a total of more than a million pounds of freight and thousands of passengers. Individual loads were up to 1,700 lb for the S-55s and 600 lb for the Bells. At least one pilot made 40 trips in a single day, hauling twelve men and two tons of equipment 5,200ft up into the mountains in a 13-hour non-stop shift.

Okanagan learned a great deal about mountain-flying from this job, including how to take off at a height where normal ascents are impossible. Known as "bump jumping," this technique involves bouncing the aircraft up and down on its skids until it bumps high enough to be skidded sideways over the edge of the platform into the wide open spaces of the chasm. . . .

Such techniques are not for the nervous and are hardly likely to be found in the piloting handbook. But why should they be? The helicopter is like no other vehicle. It is unorthodox and it makes most money when used in an unorthodox way. This does not mean that it has no future for work such as flying Aunt Bessie and little Johnnie from A to B as an air-bus; but the more money that helicopters can save the customer by doing otherwise-impossible jobs, the higher will be the profits made by their operators.

The job done by Okanagan in the mountains of British Columbia could have been tackled by no other vehicle, and it pointed the way for a similar venture in the Tarentaise Alps, where the French electricity authorities planned to increase the amount of water fed into the Tignes Dam but had no way of transporting the necessary cement, sand, equipment and 20-ft pipes to the 7,900ft-high work sites. Even if it had proved practicable to build a mule track, the animals could have carried only 150 lb each at such altitudes and the pipes would have had to be cut in sections and welded on site. A single Bell 47G airlifted the lot, including 58 men—a total of 108,000 lb—in 410

Air-to-ground television transmissions from helicopters have been made experimentally to explore their possibilities for police, traffic and other reconnaissance duties. The ground-screen view of Cambridge was received from the Pye equipment seen on the right in a Sycamore.

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trips in a single week, averaging nearly 11 hours' flying each day.

Another Bell 47G, operated by Helicopter Services, Ltd., landed in the 7,515-ft high crater of Ngauruhoe, a live volcano, in New Zealand this year to set up a geophone which is being linked by cable to a Government observatory six miles away so that the volcano's future activity can be studied and recorded.

Basically, all these are flying-crane activities—and what cranes, with jibs a mile and a half high! Some already bear a "made in England" stamp, for Okanagan have completed two experimental airlifts with a Sycamore in the mountains of British Columbia. One of them, described as the most hazardous operation ever undertaken by the company, consisted of lifting a succession of 700 lb underslung loads of 45- and 10-gallon drums of fuel to an otherwise inaccessible copper mining camp 6,000ft above sea level on Mount Cheam. The loads had to be dropped from a hovering position as the Sycamore could not alight on the 50ft-thick snow.

Less spectacular, but equally helpful, was another Sycamore operation which speeded the erection of a new Trinity House navigation beacon on a wind-swept outcrop of rocks 400 yards offshore at Penmon Point, Anglesey, last spring. The aircraft first carried out the 7½-cwt topmast and lowered it into position on top of a 25-ft structure of granite and concrete, to which it was bolted by steeplejacks. After which it completed the job by flying into position the 3½-cwt topmark. This saved weeks of hazardous work in ferrying the equipment to the rocks and trying to erect it with derricks in heavy seas.

What might be described as a "flying ladder" operation was suggested by one potential customer in a letter to Bell Aircraft. His expressed interest in buying a helicopter for transportation "in and out of the South American interior" was probably quite genuine: he proved to be the inmate of a gaol.

Although gaolbirds are not numbered among regular helicopter users, their natural "enemies" are, and in Italy even the Treasury police force, equivalent to our Coastguards, have taken to the air. It seems that more and more tobacco-loving Italians were finding black-market cigarettes plentiful, cheaper and much more satisfying than the kind sold normally in government stores. Unfortunately, it was equally apparent to the Treasury police that to increase the number of available anti-smuggling patrol boats off a coastline as long as theirs would probably cost more than the tobacco revenue saved. So they bought two Agusta-Bell helicopters, which soon proved so effective that six more were ordered. Now, all patrolling is done by these aircraft, which are able to call up the surface vessels by radio when known or suspected smugglers are sighted. There is no escape even by night, for then flares are dropped at regular intervals to illuminate all shipping in the area of patrol.

More conventional is the use of a Hiller 12-C by the Los Angeles Police Department for observing traffic during peak hours and at points of congestion. Three-way radio, linking the aircraft with police headquarters and ground units, enables jams to be cleared quickly or avoided by careful traffic control and re-routing.

The New York City Police have had a small fleet of Bell 47s since 1948, using them to patrol the sky for low-flying aircraft, for rescuing the crews of overturned boats and swimmers in distress, investigating forced-landings and air accidents, making traffic surveys on week-ends and holidays, and searching for lost children and escaped convicts. Big advantage of the helicopter from their point of view is that the C.A.A. will let them operate in weather that grounds all other civil aircraft—a realistic attitude that must be accepted everywhere if helicopters are to profit from their ability to grope their way slowly through murky conditions and sit down almost anywhere if things get too bad.

Rescue operations are more likely to be needed in bad weather than good, and an added advantage is that the police allow 1½ minutes' warm-up before take-off in their helicopters, against five minutes for their fixed-wing aircraft. Every second can be precious; there was the case of one Frank Vaccaro, who, whilst fishing in Jamaica Bay, ran his boat on the mud a few hundred yards from shore. He hopped out to walk the rest, but got only a few yards before beginning to sink in the mud. He was up to the neck in it by the time even the police helicopter could get to the scene and save him.

"A practical alternative for ultra-light helicopters is the system used on the French Djinn, in which the rotor is turned simply by compressed air ejected from the tips without burning." This Djinn was photographed recently in Mexico at an altitude of over 12,000ft. In the background is the famous volcano Popocatepetl.

"Power-line patrol has grown from a bright idea to a money-saver for electricity authorities in Europe as well as in the United States."

On another occasion, Patrolman Behrens performed a feat worthy of Hollywood by dropping from a helicopter piloted by another policeman on to a motor boat that had shed its passengers and proceeded to career around Sheepshead Bay, threatening to ram every other boat in sight. After getting the boat under control and to its moorings, Behrens rejoined the helicopter and got back to his aerial beat.

Even the Sheriff's Department in Los Angeles County has its own private helicopter for law enforcement and rescue duties. In slack periods, it has helped pay off its £13,000 cost by re-seeding 1,800 acres of burned watershed for the County Fire Department and assisting in air pollution surveys.

Talk of sheriffs naturally brings us to cowboys—more specifically, to the flying cowboys of the 500,000-acre Waggoner Ranch, which is quite sizeable even for Texas, where everything is bigger than life size. This certainly is an unorthodox operation, because it takes advantage of one of the helicopter's main drawbacks—noise—to flush cattle out of the *mesquite* for branding. In a working day that starts around 5.30 a.m. the pilot spends some three hours looking for unbranded calves and chasing them out of the tall thickets which are difficult for horsemen to penetrate. As the Herefords race away from the noise and downwash a mere 20ft above them, they can be rounded up easily by the waiting cowboys for branding. Around 100 calves a day can be dealt with

One of the Westland Whirlwinds operated by Bristow Helicopters for Royal Dutch Shell. It is seen landing on the platform of an oil drilling rig 50 miles offshore in the Persian Gulf. Two of these aircraft are used to carry materials and workmen to the rig, which is seen in the upper picture. Weather often prevents boats coming alongside.

in a six-week period, against a daily average of 50 by traditional methods, and the ranch foreman reckons the helicopter is equivalent to 15 or 20 cowboys on good horses. Presumably the current shortage of skilled men prevents any complaints from the cowboys' union.

As well as herding cattle, the helicopter is used on the Waggoner Ranch for coyote hunting, and for fence and water-tank inspection. The scope of the latter task can be gathered from the fact that it takes some 2,700 miles of barbed-wire fencing to keep the 15,000 cattle in and other animals out. Only a helicopter can land anywhere and at any time for the inspection and repair of holes.

All this might be considered a variation of one of the helicopter's earliest commercial applications, because it was not long after the war that pest-control gear was first fitted to a Sikorsky S-51 to turn it into a flying farm implement. This job was a "natural," because a farm crop represents a considerable financial investment and spraying by horse-drawn equipment inevitably trampled down a proportion of the crop it was trying to save. By contrast, a helicopter could cruise slowly overhead, spreading quickly a wide swath of insecticide spray or dust without damaging so much as one leaf. The technique has been adopted throughout the world and Fison-Airwork, the British pioneers of pest-control, are even spraying experimentally and successfully at the present time areas of Jamaican banana trees, the leaves of which have always been considered too delicate to survive the rotor downwash.

Vast quantities of foodstuffs, cotton and other crops have been saved by this work, and the technique has been developed to combat the menace of locusts, malarial mosquitoes and other insects that threaten man's survival in many areas of the world.

A helicopter is used on a big Texas ranch for rounding-up cattle, particularly in areas where they cannot easily be reached by horsemen.

Much has been achieved; but there is far more yet to be done and this must surely be one of the most worthwhile of all jobs, where the cost in terms of pounds, dollars and roubles is unimportant.

Forests, as well as farms, are protected by aerial spraying; but men and lightning are no less of a menace in timber country, and helicopters are being used on an increasing scale to supplement fixed-wing aircraft for forest fire patrol and fire-fighting duties. For the first time, fire-fighters can be delivered to the doorstep of a blaze, without having to parachute down, so that they can often tackle it in the early stages, before it grows into a relentless forest-devouring monster. Not only this, but Forest Service officers can co-ordinate the offensive by radio from helicopter to ground units equipped with walkie-talkie sets. Injured and fatigued fire-fighters can be evacuated easily; and helicopters can be used to trail hoses from the pumps to the heart of the blaze.

Great progress has been made in aerial fire-fighting as a result of programmes like "Operation Firestop," in which an S-55, Hiller 12-B and Bell 47 were used for "water bombing" experiments and to lay hose. In addition, the S-55 dropped 100 gallons of water at a time by free fall on spot fires and along fire lines, with marked success; and it proved its ability to deliver a small hook-on "helitanker" made up of a 100-gallon tank, small pump and 300ft of hose, together with the personnel to man it.

Results are impressive. In the Northern Rocky Mountain Region, fires destroyed about $40 million worth of timber each year between 1905 and 1930, when the firefighters' speed was 2½ m.p.h. on foot and horseback. Between 1930 and 1940, the damage was reduced to an annual $3½ million by 15 m.p.h. motor transport. Aerial fire-fighting has now cut the bill to under $350,000 a year. Even helicopters are cheap when they can help save that kind of money.

Nor should we dismiss as a mere stunt a recent demonstration

A Kaman HOK-1 is demonstrated in the rôle of airfield fire-tender as described in the paragraph immediately above.

The helicopter has great value as a V.I.P. transport, particularly by virtue of its independence of airfields, and the British Royal Family frequently make use of this form of transport. Here Queen Elizabeth the Queen Mother is alighting from a Westland Dragonfly.

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in which men with fire-fighting equipment were landed near a burning fighter aircraft by a small helicopter, which then used the downwash from its rotors to lay back the smoke and flames from the aircraft's cockpit while a dummy pilot was extricated. So many of the helicopters' present jobs looked like stunts when they were first suggested; now the machines have proved their worth a thousandfold as rescue vehicles. During the tragic floods in the Netherlands in 1953, seven small U.S. Navy helicopters alone snatched 450 victims from trees, roof-tops and high ground.

Those folk who complain that life would be happier if aeroplanes had never been invented often expressly exclude the helicopter, whose main job seems to be to save life, money and time. But even the convinced helicopter enthusiast seldom realizes the tremendous scope of this job.

Use of the helicopter has revolutionized the topographic mapping of rugged and remote areas, by transporting surveyors and instruments to inaccessible stations in mountains, swamps, deserts and even the Antarctic. The modern uranium prospector cruises along at 35 m.p.h., less than 100ft above the ground in a helicopter with its airborne scintillometer scintillating madly whenever it passes over a hidden cache of radioactive ore.

Power-line patrol has grown from a bright idea to a money-saver for electricity authorities in Europe as well as in the United States. Extra pairs of wide-ranging eyes in helicopters help ice-breakers of the U.S. Coastguard Service and Royal Canadian Navy to keep open the Arctic sea lanes for cargo ships as long as seasonal weather permits.

All the best whaling fleets now take along a helicopter or two for spotting duty, and the result has been record catches in shorter periods at sea. Off the coast of Newfoundland and in the Gulf of St. Lawrence the life expectancy of seals has decreased alarmingly since the hunters forsook the crow's-nest of a ship for the cockpit of a helicopter. The New York Trap Rock Company even uses a helicopter to deliver pay-packets to the men who keep its 200 barges moving between New York harbour and plants as far as 85 miles up the Hudson river, in "Operation Rock and Payroll."

But what of the personal helicopter and air-bus?

At the moment operating costs are far too high except for specialized operations such as conveying workmen to drilling rigs out at sea. Oil companies in several parts of the world have found this worth while to avoid the time-loss and uncertainty of transport by boat, and it is a comparatively easy business to tack a landing platform onto the side of a rig.

There are one or two businessmen who consider it worth while to use helicopters for commuting between home and office. Doyen of these is Mr. Richard Fairey, who pilots himself between the dispersed factories of the Fairey Aviation Group; whilst Mr. Frederick Matthaei of the American Metal Products Company estimates that his helicopter saves him 200 hours travelling a year in a country where the time of senior executives is often valued at $100 to $200 an hour. His Bell 47H costs an estimated $75 an hour to operate.

Now that the prototype Rotodyne is approaching completion, the air-bus is threatened more by official lack of foresight than by economical or technical considerations. The city fathers who refused permission for Twin Pioneers to fly from Wormwood Scrubbs would certainly throw up their hands in horror at the thought of robbing their parishioners of a slice of Hyde Park so that helicopters could link London with Paris or Manchester or Edinburgh in half the time taken by trains and fixed-wing airliners. In their own ostrich-headedness, they do not see the thousands of people who flock to London Airport to watch the operations of far-less-interesting fixed-wing aircraft. If they did, they would open a helicopter landing site in Hyde Park, charge visitors a shilling to watch the goings-on and use the proceeds to help build a real heliport above one of the London railway stations.

They argue that the public would object to the noise of helicopters; yet even this may be overcome, for Faireys have already reduced the noise level of the Rotodyne by ten decibels, can certainly get out a further five decibels and aim at getting down to 95 decibels at 200ft, which is about the same as an S-55 and only ten decibels more than the street noise in the West End of London at peak periods.

How far ahead? Roof-top helicopter sites in cities are still largely in the future: few have been built, even in America, and fewer still used regularly. The aircraft in this picture is a Bell 47H.

Nor can they question the safety of helicopters, for there has been not a single passenger fatality in six years of scheduled helicopter passenger service in the United States and Europe.

Some problems remain, because even in America only four of the 48 states recognize the helicopter as a separate and distinct form of aircraft, not needing to be subject to the same stringent regulations governing altitude and visibility limitations and approach zone requirements for landing and take-off as fixed-wing aircraft. New traffic control procedures must be worked out and there must be more programmes like Bell's IMHEP (Ideal Man-Helicopter Engineering Project) aimed at easing the task of the pilot by methods such as the presentation of all flight information on a single flat cathode ray tube during bad-weather and night operations.

At the moment there are no grounds for optimism on the future of transport helicopters because, so far as this country is concerned, even when we have the world's finest aircraft there is little prospect that they will be allowed to operate efficiently. If they can be flown only from airports, it will always be cheaper and faster by fixed-wing airliner, and the helicopter air-bus will die.

There are 65,000,000 potential air-bus passengers within a 200-mile radius of London and it is unthinkable that there is no room in the world's greatest city for a landing area 400ft by 200ft, which is the size recommended by I.A.T.A. as adequate for 40 movements an hour by large multi-engined helicopters.

Surely the time has come for helicopters, not excuses?

Helicopter Powerplants

GREAT BRITAIN

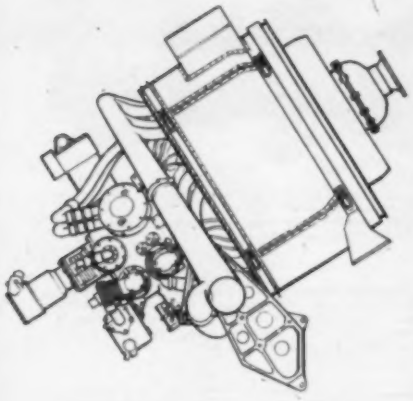
ALVIS, LTD.

Holyhead Road, Coventry.
(Coventry 5501)

With a single design of piston engine (the Leonides, described below) this company have long enjoyed a near-monopoly in the propulsion of British rotary-wing machines. Although Alvis are at present virtually the only British aero-engine firm which has not announced any plans for gas-turbine work, their two current production aero engines will probably be made for many years, particularly for helicopter applications.

Leonides Although of completely conventional geometry, this trim radial air-cooled engine is one of the most efficient units available for helicopter propulsion. For its size it has a remarkably high output, partly as a result of its high operating r.p.m. In most helicopter installations the Leonides is mounted either with the crankshaft horizontal, as in the Westland Dragonfly, or vertical, as in the Bristol Sycamore. It is supercharged, has a Hobson injection-type carburettor, and in helicopter form has a direct drive with conventional clutch and cooling fan.

Leonides Major Using fourteen Leonides-size cylinders in two staggered rows the Major is actually of rather lower overall diameter than its smaller forbear. Owing to its important position in being the only British unit in the range from 500 to well over 1,000 h.p. the development of the Major is being advanced at high priority and very extensive bench and flight testing has already been completed. The helicopter version illustrated in the drawing is for the Westland Whirlwind, the engine being mounted with the crankshaft at 35 deg to the horizontal. A vertical-crankshaft variant has also been prepared to suit the requirements of the Bristol twin-rotor helicopter family. For these applications the maximum continuous rating will be 645 h.p. and the max. w.m. cruise 530 h.p.



Alvis Leonides Major A.L.E.M.1-2. Helicopter engine. Two-row 14-cylinder piston engine mounted at 35 deg (in S-55) with supercharger and direct drive with cooling fan. Overall diameter, 38.9in (basic engine); length as shown, about 55in; bore, 4.8in; stroke, 4.41in; swept volume, 1,118 cu in; dry weight, approximately 1,000 lb; maximum rating, 850 h.p. at sea level at 2,900 r.p.m. with 8 lb/sq in boost.

BLACKBURN AND GENERAL AIRCRAFT, LTD.

Brough, E. Yorks.
(Brough 121)

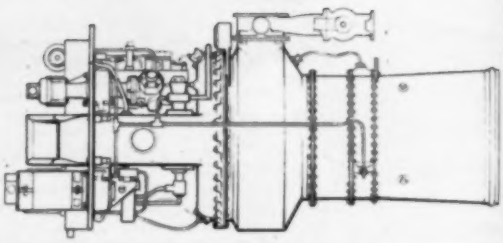
Long renowned for their Cirrus range of piston engines, this firm are in limited production with the last of this family, the Bombardier, which powers the Mk 5 version of the Saro Skeeter. Development is, however, concentrated almost entirely on the rationalized range of small gas turbines based originally on the designs of the Société Turboméca. For helicopters the chief units are the Palouste, Turmo and Twin Turmo. Although no full production contracts have been placed for these the first-named is likely to be built in numbers as the standard powerplant of the Fairey Ultra-Light helicopter.

Alvis Leonides Mk 73 (helicopter) nine-cylinder, air-cooled poppet-valve radial, with crankshaft vertical, fan cooling and no reduction gearbox. Cylinder bore and stroke, 4.8 by 4.41in; swept volume, 718.6 cu in (11.78 litres); overall diameter, 41.5in; overall height, 32.83in; dry weight, 642 lb; maximum power, 540 b.h.p. at 3,200 r.p.m. at 7 lb boost.

Bombardier One of the most up-to-date engines of its class, the Bombardier has direct fuel-injection into the cylinder heads. In the Skeeter 5 it is mounted athwartships, with a direct drive and fan cooling. Ratings vary from 173 to 200 h.p.

Palouste Except for the small amount of shaft-power taken out through the wheelcase at the intake end to drive the various accessories this unit delivers all its power in the form of a flow of compressed air. The centrifugal compressor is of a size greater than the turbine mass flow requires and the excess delivery is extracted from a large pipe-attachment face above the centre of the unit communicating with a peripheral collection manifold around the combustion chamber. In the Ultra-Light helicopter the air is trunked up to the rotor hub and thence to pressure jets at the blade tips where fuel (kerosine, similar to that supplied to the Palouste) is burnt to increase the rotor horse-power. The exhaust from the Palouste is ejected to the rear to assist in increasing the effectiveness of the rudder.

Turmo Broadly speaking, this engine consists of a turbojet with a mechanically independent turbine added behind the compressor-turbine to provide a "flexible" source of shaft power suitable for helicopters. The exhaust is taken out through a diagonally sloping trunk, to the rear of which is bolted the reduction gearbox.



Palouste, air-compressing gas turbine. Single-sided centrifugal compressor, annular combustion chamber with rotating fuel-injection nozzles, and single-stage turbine. Maximum diameter, 17.7in; height, about 18in; length, basic engine, 28.62in; dry weight, 178 lb; delivery 2.725 lb/sec air at 41.55 lb/sq in gauge, with fuel consumption of 310 lb/hr.

Twin Turmo Developing up to 900 s.h.p. the Twin Turmo is formed by connecting two Turmo power sections to a single gearbox. All the power is taken out through a single shaft, free wheels being provided on the gearbox layshafts to permit either power section to be shut down. A version of the Twin Turmo was prepared for installation in the Westland Whirlwind, and in this aircraft it would have been possible to cruise on either half-engine at full load.

DE HAVILLAND ENGINE CO., LTD.

Leavesden, Herts.
(Garston 4000)

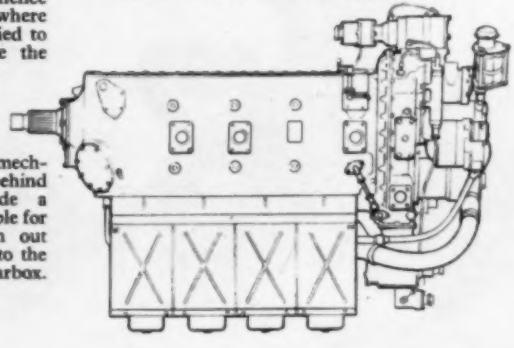
Gipsy Major Standard power unit of the Saro Skeeter 6 is the Gipsy Major 200-series piston engine, the latest member of what is perhaps the most famous family of engines in the world. Compared with most of the Gipsy Majors in current use, the 200 has a rather larger swept volume and direct petrol-injection into the cylinders. In the Skeeter the Major is mounted transversely, with the drive carried up the starboard side through a gear train to the main and tail rotors. A standard clutch and belt-driven cooling fan are incorporated.

D. NAPIER AND SON, LTD.

211 The Vale, Acton, London, W.3.
(Shepherds Bush 1220)

Perhaps to a greater extent than any other company Napier are devoting their aeronautical energies towards the propulsion of helicopters. They now have three efficient and attractive—and, in many ways, unique—single-shaft axial gas tur-

de Havilland Gipsy Major 200. Piston engine. Four inverted cylinders with air-cooling and direct fuel injection into the inlet ports, with direct drive. Width, 16.8in; height, 29.8in; length, 51in; bore, 4.725in; stroke, 5.905in; swept volume, 416 cu in; dry weight, 400 lb; maximum rating, 192-200 h.p. at sea level at 2,600 r.p.m. with consumption of 104-108 lb/hr.



Helicopter Powerplants...

bines all specially designed for rotary-wing applications and all in a high state of development.

Eland Although the original Eland was intended for fixed-wing aircraft, in which field it is still of prime importance, a derivative, designated Eland E.151 (NEI.3 rating) has been prepared to meet the specialized requirements of the Fairey Rotodyne helicopter. Virtually the whole of the basic Eland is retained, and to the rear has been added a hydraulic coupling which, when filled with fluid, drives an auxiliary compressor which feeds fresh air up to the pressure jets on the rotor blades. When the Rotodyne takes off, nearly all the power is absorbed by the rotor, which is used solely for lift; the conventional propellers are held in very fine pitch and are employed for yawing control. For full forward flight the hydraulic clutch is gradually drained, thus cutting off the drive to the auxiliary compressor (and also the power to the rotor) while the propeller pitch is increased. In the cruising configuration the machine is supported by its fixed wing and autorotating rotor and is driven forwards by the propellers.

Gazelle Under intensive development for both the Westland Wessex for the Royal Navy and the Bristol 192 series for the R.A.F. and Army, the Gazelle is a free-turbine shaft-drive engine which is likely to prove of the greatest value. As the accompanying cut-away drawing reveals, the general layout is quite conventional—apart from the fact that the unit is shown vertical. The Gazelle has actually been designed for installation at any angle, and in its vertical form has most of the accessories mounted on the upper face of the large disc-like intake casting at the lower end. Exhaust is taken out through split trunks at the upper end, between which is the epicyclic reduction gearbox. Single-lever control is provided, with automatic compensation for variation in ambient temperature and pressure and turbine-inlet temperature, and with automatic torque limitation. Development is aimed at various powers between 1,000 and 2,000 s.h.p. and has so far been extremely encouraging.

Oryx All the output of this unique engine is in the form of a steady flow of gas at a temperature and pressure suitable for helicopter tip-drive without tip burning. The two-stage turbine is oversize in comparison with the compressor, and the surplus power is used to turn a permanently coupled auxiliary compressor which feeds fresh air to a mixing box where it dilutes the exhaust from the power section. The final mixture has a temperature and pressure, under maximum-power conditions, of 678 deg K and 23.5 lb/sq in abs.

Booster rockets During the past year Napier and Saunders-Roe have been jointly developing a very neat booster arrangement which, for a very modest weight penalty, can multiply many times the excess rotor power available for climbing. High-test peroxide is contained in a tank mounted above the rotor hub, from which it is fed to the rotor blades by gravity. Centrifugal force then causes the H.T.P. to build up a high pressure and flow through restrictor bleeds and thence pass to catalyst packs of silver gauze at the tips of the blades. The decomposed peroxide finally escapes through rearward-facing propulsive nozzles. The installation on the Skeeter 5 has already been extensively test-flown and has been found to raise the vertical rate of climb at full load from about 230 to 1,400ft/min. The overall weight is given as under 120 lb for a booster duration of some 2½ min, 90 lb of the total being accounted for by the H.T.P.

SAUNDERS-ROE, LTD.

E. Cowes, Isle of Wight.
(Cowes 2211)

This versatile firm is possibly unique in that it is a helicopter manufacturing company which has more than dabbled in the design and development of helicopter powerplants. Since 1951 Saro have been actively developing small flapper-valve pulsejet units for tip-drive applications. No details of current work may be published since it is under Government contract.

FRANCE

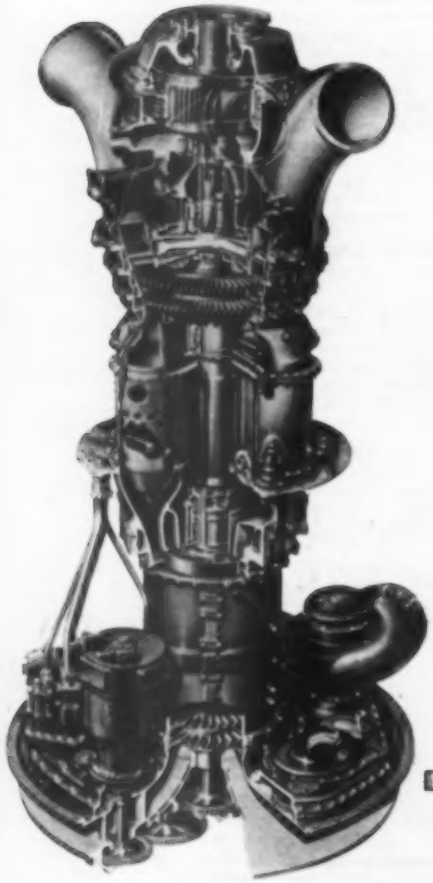
SOCIETE TURBOMECA

Bordes, Basses-Pyrénées.
(Pau 49.31)

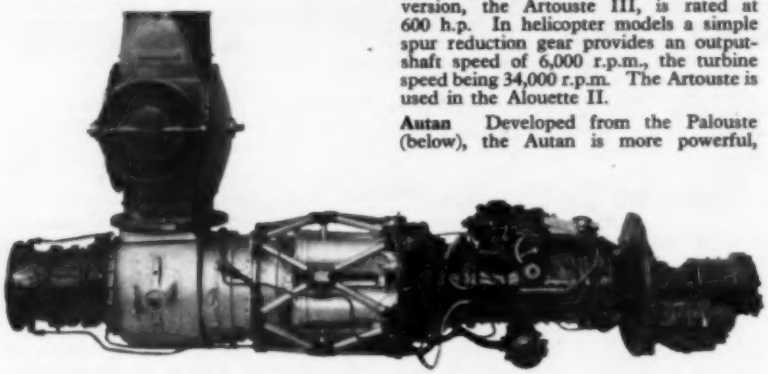
With the later types of S. E. Alouette and S. O. Djinn in full production, Turboméca are delivering fair numbers of small gas turbines for helicopter applications.

Artouste A single-shaft engine, the Artouste delivers up to 400 s.h.p. in present production forms and an advanced version, the Artouste III, is rated at 600 h.p. In helicopter models a simple spur reduction gear provides an output-shaft speed of 6,000 r.p.m., the turbine speed being 34,000 r.p.m. The Artouste is used in the Alouette II.

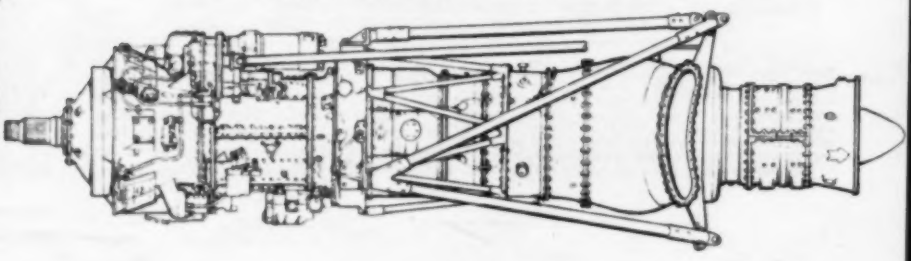
Autan Developed from the Palouste (below), the Autan is more powerful,



Napier Gazelle NG.1. Free-turbine helicopter engine. Multi-stage compressor, annular combustion chamber with six flame tubes and independent compressor- and power-turbines. Overall height, about 70in; maximum diameter at intake, 33½in; dry weight, restricted; mass flow and pressure ratio, restricted; maximum rating (5-min), 1,260 s.h.p. (net residual thrust, 260 lb) at 20,400 compressor r.p.m. and output-shaft speed of 8,000 r.p.m.; one-hour rating, 1,100 s.h.p. at 19,800 r.p.m. (output, 3,000 r.p.m.); continuous, 920 s.h.p. at 19,000 r.p.m. (output, 3,300 r.p.m.). Other ratings are NG.2 (1,650 s.h.p.), NG.3 (1,800) and NG.4 (2,000).



Napier Oryx (NOr.5 rating). Single-shaft turbo gas-generator. Twelve-stage compressor, five combustion chambers and two-stage turbine; four-stage auxiliary compressor. Diameter, 19½in; length, 83½in; dry weight, 500 lb; mass flow, 15.3 lb/sec; pressure ratio, 6.15:1 (overall pressure ratio of gas from delivery valve, 1.7:1); maximum output, 950 gas h.p. at 22,600 r.p.m. with s.f.c. of 0.62.



Napier Eland E.151 (NEI.3). Rotodyne powerplant. Ten-stage compressor, six combustion chambers and three-stage turbine, the rotating assembly being coupled to a propeller reduction gear at the front end (via a fluid clutch) a nine-stage auxiliary compressor at the rear. Overall diameter, about 40in (basic, 36in); length, 158.25in; dry weight, 2,350 lb; mass flow, 31 lb/sec; pressure ratio, 7:1; maximum power (forward flight), 3,000 e.h.p. (2,800 s.h.p.+500 lb) at 12,500 r.p.m. with s.f.c. of 0.624.

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Helicopter Powerplants...

having a rated delivery of 3 lb of air per second. Although not yet used in helicopters it is scheduled to power later models of Djinn. It was described and illustrated in our issue of May 11 last.

Palouste This air-compressing gas turbine is now widely used, and is the powerplant of present Djinn pressure-jet helicopters. The latest version, the Palouste IV, delivers up to 2.4 lb of air per second at 33,000 r.p.m., equal to 1,785 cu ft/min of free air or horse-power of 190. An anglicized version is described and illustrated on an earlier page.

U.S.A.

AIRCOOLED MOTORS, INC.

Syracuse 8, N.Y.
(69-2711)

Recently this company—makers of "Franklin" engines—claimed that their neat, air-cooled, flat-six units were fitted to three-quarters of all the helicopters delivered from American factories.

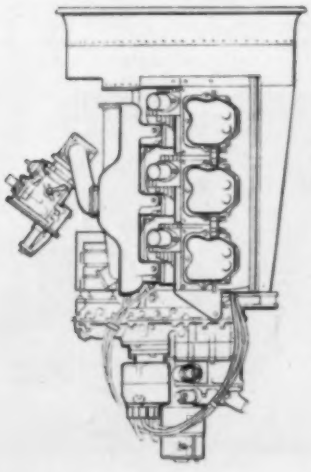
O-335 Also known as the 6V4, this unit has been built in very large numbers for Hillers and Bells. In both machines the engine is mounted with the crankshaft vertical and is provided with a clutch and cooling fan at the upper (drive) end. The six cylinders each have a bore and stroke of, respectively, 4.5 and 3.5in, resulting in a swept volume of 335 cu in. A typical dry weight for the 1946-53 engines is 311 lb and the maximum rating 178 h.p. at 3,000 r.p.m. Current production Bells and Hillers have a higher-compression 6V4 running on 91-98 octane fuel and rated at 200 h.p.

O-425 Of very similar layout to the O-335 (and also designated 6V6) this unit is rather larger, the cylinder size being 4.75 by 4.0in. The standard helicopter rating is 245 h.p. A development, designated O-425-2, has a positive-displacement supercharger driven from the crankshaft and can maintain a maximum rating of 300 h.p. up to 8,200ft. It is sponsored by the U.S. Navy. A further development, which is at present being evaluated in a Sikorsky S-52, is the turbo-supercharged O-425-13. The exhaust gas drives a single-stage turbine which is directly coupled to a shrouded centrifugal blower.

ALLISON DIVISION OF GENERAL MOTORS CORPORATION

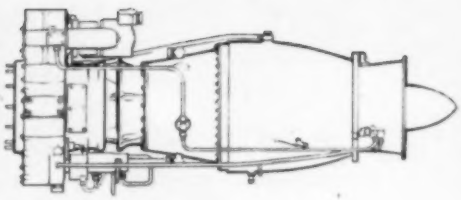
Indianapolis, Ind.
(Belmont 1541)

Neither of the units described in next column is in production but they are of unusual technical interest.



Aircooled-Franklin O-425-13. Helicopter piston engine. Six horizontally-opposed air-cooled cylinders, direct drive with cooling fan; exhaust-driven turbo-supercharger (not shown) mounted on the airframe. Vertical crankshaft. Width, 34.2in (over valve covers); height, 40in; bore, 4.75in; stroke, 4in; swept volume, 425 cu in; dry weight, 462 lb (including turbo-supercharger); maximum rating, 300 h.p. at 3,275 r.p.m. with 4 lb/sq in boost.

Turboméca Artouste III. Single-shaft turboprop. One axial compressor stage followed by a single-sided centrifugal stage, annular combustion chamber and two-stage turbine. Overall height, 22in; width, 17.8in; length, approximately 68in; dry weight, 333 lb; mass flow, about 8.8 lb/sec; pressure ratio, 5.1:1; take-off rating, 645 s.h.p. with 6,000 r.p.m. output-shaft speed and s.f.c. of 0.73; m.o.t.o., 525 h.p.



J35 This turbojet was originally of General Electric design, and started life with the designation TG-180. Two of these early units were considerably modified for use as gas producers and were employed on the giant tip-drive Hughes XH-17 "flying crane."

T56 A special derivative of this single-shaft turbine has been prepared to suit the large, twin-rotor Vertol (ex-Piasecki) YH-16A Transporter. Originally this was to have had a T38 engine but the more powerful T56 was actually ready in time for use in the prototype. The U.S. Armed Services designation of the unit was T56-A-5, and the design rating was 3,500 s.h.p.

BOEING AIRPLANE COMPANY

Seattle, Wash.
(Mohawk 3333)

Since the end of World War 2 this large aircraft firm have been actively developing a range of small gas turbines. In general, these engines have a single-sided centrifugal compressor and provide shaft power from a single-stage free turbine. Although their production applications are in other fields it is worth noting that experimental Boeing Model 502 units were successfully fitted to American helicopters, the latter being the first gas-turbine-powered rotary-wing machines to fly. The first installation was made in a Kaman K-225 helicopter, a single 175 h.p. Boeing YT50 being employed. This aircraft flew on turbine power in December 1951. In March 1954 a Kaman HTK helicopter flew on the power of a pair of Boeing 502-2 units, each rated at 190 s.h.p. Both units were arranged to drive through clutches so that either could be shut down for cruising flight.

CONTINENTAL AVIATION AND ENGINEERING CORPORATION

Detroit, Mich.
(Valley 2-1500)

Long renowned for their widely used piston engines, Continental are now in full production with small gas turbines based on the Turboméca designs. Certain of these units, particularly the "Artouste-derivatives," are used in American helicopters.

R-975 This well-tried radial engine has been highly developed for rotary-wing applications and is the standard powerplant of most of the Vertol HUP and H-25 tandem-rotor machines. The helicopter R-975 can be mounted at any angle and in the HUP it is installed as a quickly removable package complete with lubrication system and cooling fan. Earlier HUPs were fitted with the 525 h.p. R-975-34 but the 550 h.p. -42 is more common. A single-speed supercharger and injection-type carburettor are standard.

Model 140 Based on the Turboméca Palouste (*q.v.*), this air-compressor delivers up to 1,500 cu ft of free air per minute. Although potentially a helicopter engine, its chief production use in the U.S.A. is the starting of large gas turbines by pneumatic power.

Model 210-1 Also known as the T51-T-1, this is a single-shaft turboprop unit with a gas-generator section based on that of the Turboméca Artouste I. Weighing 266 lb complete with 15.2:1 reduction gear, the 210 is rated at 280 s.h.p. at sea level at 35,000 r.p.m. It is installed in the Bell XH-13F.

Model 220-2 Having a gas-generating system like a scaled-up version of that of the 210, the 220 has a mass flow of 7 lb/sec, compared with the 4.4 of the smaller unit. As a consequence the shaft-power is raised to a maximum of 425 s.h.p. at 34,800 r.p.m., equivalent to the French Artouste II. The Model 220-2, known by the U.S. Services as the T51-T-3, is installed in the Sikorsky XH-39 which recently established world helicopter records for altitude and speed.

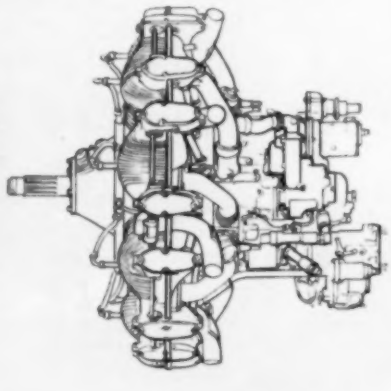
Model 260 With the Service designation T51-T-5, this unit is a free-turbine engine derived from the Model 220 and with a roughly similar rating of 400 s.h.p. Flight trials with an XT51-T-5 installed in the XH-39 will be used to compare the behaviour of the free-turbine with the less-flexible T51-T-3.

GENERAL ELECTRIC CO.

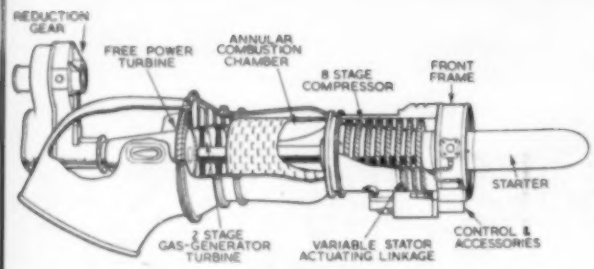
Aircraft Gas Turbine Division,
Cincinnati 15, Ohio.
(Popular 1-4100)

Although more than 40,000 turbojets of G.E. design have now been delivered to the U.S. Air Force and Navy the company's experience of helicopter propulsion is only just beginning. The T58 free-turbine engine is, however, one of the most advanced and attractive shaft-drive units of its class.

T58 As the simplified cut-away drawing reveals, this unit has an axial com-



Continental R-975-42 nine-cylinder, air-cooled, poppet-valve radial for helicopters, ungeared but supercharged and with injection-type carburettor (note: the valve-gear push rods lie behind the cylinders). Bore, 5in; stroke, 5.5in; swept volume, 973 cu in (15.9 litres); diameter, 45.5in; length or height (according to installation), 42.4in; dry weight, 730 lb; maximum power, 550 h.p. at 2,400 r.p.m. at 6.8 lb boost at sea level.



General Electric YT58-GE-2. Free-turbine shaft-drive engine. Multi-stage compressor, annular combustion chamber and two mechanically independent turbine stages. Reduction gear and output at end opposite to intake. Approximate dimensions: width, 15in; height, 20in; length, 62in; dry weight, about 480 lb; maximum output, 850-950 s.h.p. with s.f.c. of about 0.70. Several versions exist.

Helicopter Powerplants...

pressor of very small diameter, the high pressure ratio of which has been made possible by the adoption of several stages of variable-incidence stator blades of the type pioneered by the company's J79 turbojet. The reduction gear is driven by the mechanically independent power turbine and is normally bolted above the rear of the engine on the side opposite to the exhaust trunk. The T58 was developed for the U.S. Navy and is scheduled to be used in several new helicopters.

HILLER HELICOPTERS

Palo Alto, California.
(Davenport 5-3241)

Although not primarily an engine company at all, Hiller are one of the only two firms to have produced a helicopter tip-drive ramjet in quantity. It is fitted to the H-32 light helicopter, used by the U.S. Navy as the HOE.

8RJ-2B Now fully developed after six years of research and bench trials this neat subsonic ramjet is one of the simplest and cheapest helicopter powerplants imaginable. It can be employed on any rotor of about 23ft diameter designed to operate at about 550 r.p.m. (equivalent to a tip speed of 662ft/sec). An unrestricted C.A.A. certificate is held.

LYCOMING, DIVISION OF AVCO MANUFACTURING CORP.

Stratford, Connecticut.
(Drexel 8-0431)

During the past few years this renowned manufacturer of small piston engines has turned over much of its aero-engine research to gas turbines. The T53 is already of major importance in the propulsion of helicopters. In addition to these units and to the other engines described below, Lycoming are the sole American manufacturers of the helicopter engines designed by the Curtiss-Wright Corpn.

O-435 This flat-six has a swept volume of 434 cu in and the helicopter version weighs from 405 to 425 lb and is rated at 245 h.p. at 3,200 r.p.m. Another helicopter unit, used in certain Bell machines, is the VO-435 rated at 260 h.p. at 3,400 r.p.m. and weighing only 391 lb.

O-580 This flat-eight has the same cylinder as the O-435. The helicopter versions weigh from 578 to 591 lb, without gearbox, and are rated at 400 h.p. at 3,300 r.p.m. with 5.8 lb/sq in boost from the single-speed supercharger. The O-580 powers the Doman and Doman-Fleet machines.

T53 First product of a team led by Dr. Anselm Franz (designer of Junkers gas turbines), the T53 is a free-turbine unit from which shaft power may be extracted at either end. A trial installation has been made in a Kaman HOK, and versions of the T53 are also scheduled to power the Bell XH-40 and Model 204 and the projected enlarged Doman H-31.

T55 At present undergoing development running in the 1,500-1,750 s.h.p. range, the T55 is a scaled-up T53. Helicopter applications are foreseen.

MARQUARDT AIRCRAFT CO.

Van Nuys, California.
(Stanley 7-2811)

Specialists in ramjets for all applications, Marquardt have developed several designs of subsonic ramjet for helicopter tip-drive. A particularly noteworthy activity is the evolution of a series of booster units of aerofoil section which form extensions to the rotor blades. Air is taken in along the leading edge, decelerated in an internal diffuser upstream of a flame-holder strip and mixed with burning fuel to form a propulsive jet along the trailing edge. A typical pattern extends 15in spanwise along a chord of 16.5in and provides 400 lb-thrust at normal rotor r.p.m. This has been found to double the payload of a 6,400 lb helicopter.

PRATT AND WHITNEY AIRCRAFT

East Hartford, Connecticut.
(Jackson 8-4811)

Largest aero-engine company in the world, Pratt and Whitney are a member of United Aircraft, another member of which is Sikorsky. The S-51 was powered by a 450 h.p. R-985 Wasp Junior, and the first batches of S-55s were all fitted with the larger R-1340 Wasp, rated at 600 h.p. and weighing 865 lb with direct drive, clutch and fan. Production was completed solely by Canadian Pratt and Whitney.

R-2800 Virtually no details of the helicopter versions of this large 18-cylinder radial have been made public, although it is one of the most important rotary-wing powerplants in the world. In the S-56 two R-2800-50s are mounted on the ends of the stub wing, with the crankshafts toed inwards and the accessories facing outboard. In the Bell Model 61 a single R-2800 is mounted in a pivoting cradle in the rear fuselage. The rating is 2,400 h.p., with 1,900 available continuously.

REACTION MOTORS, INC.

Denville, New Jersey.
(Rockaway 9-2323)

As well as being one of the world's biggest rocket-motor firms, R.M.I. have developed a "Rocket-on-Rotor" system for boosting helicopter performance. Evaluated on numerous Sikorsky S-55s—chiefly of the U.S. Navy—the system comprises a peroxide tank mounted above the hub feeding catalyst packs and propulsive jets at the blade tips. The S-55 system weighs about 70 lb and puts 120 additional h.p. into the rotor. R.M.I. also make the miniature 16 lb-thrust peroxide rockets fitted to the Rotor-craft RH-1 and Kellett KH-15 helicopters. In both cases the nozzles are fed from pressurized tanks on the hull.

WRIGHT AERONAUTICAL

Division of Curtiss-Wright Corpn. Wood-Ridge, New Jersey.
(Prescott 7-2900)

Two of the most important helicopter units are those described below. Neither is any longer made by the parent firm, production and all other responsibility being vested in Lycoming.

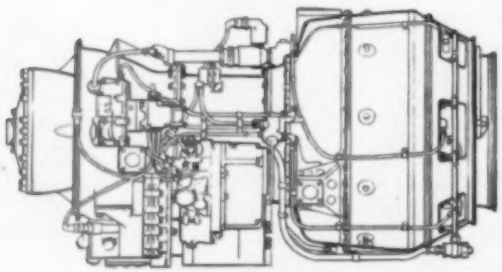
R-1300 Rated at 800 h.p. this seven-cylinder radial is fitted to nearly all the later S-55 helicopters, together with a substantial proportion of the Whirlwinds made by Westland. In these machines the engine has a direct drive from a crankshaft at 39 deg to the horizontal.

R-1820 The principal versions are the R-1820-84, used in the S-58 in all its versions, and the R-1820-103 used in the various Vertol Work-Horses. Both are direct-drive units fitted with an injection-type carburettor.

U.S.S.R.

Little detailed information is available, but it is known that helicopter versions exist of several of the medium-power radial piston engines. The most used helicopter unit appears to be the ASZ-21, of from 540 to 700 h.p. It is mounted with crankshaft horizontal in the Mi-1. The larger Mi-4 is believed to have a nine-cylinder ASH-62IR (derived originally from the Wright R-1820) rated at 1,000 h.p., and two such units are reported to be fitted to the tandem-rotor Yak-24.

Lycoming T53-L-1 (also designated LTC1B-1). Free-turbine shaft-drive engine. Compressor has five axial and one centrifugal stage and is driven by single-stage turbine. Power turbine also has a single stage and drives output shaft at either end. Annular combustion chamber with 12 upstream burners. Diameter, 23in; length, 48.6in; dry weight, 460 lb; mass flow, 10.8 lb/sec; pressure ratio, 5.9:1; maximum rating, 825 s.h.p. at 21,500 r.p.m. with s.f.c. of 0.72.



Lycoming-built Wright R-1820-84 installation in S-58. Nine-cylinder single-row radial piston engine with poppet valves, injection carburettor, supercharger, cooling fan and clutch. Bore, 6.125in; stroke, 6.875in; swept volume, 1,823 cu in; diameter, 54.9in; dry weight, 1,380 lb; maximum rating, 1,525 h.p. at 2,800 r.p.m. (145-grade fuel).

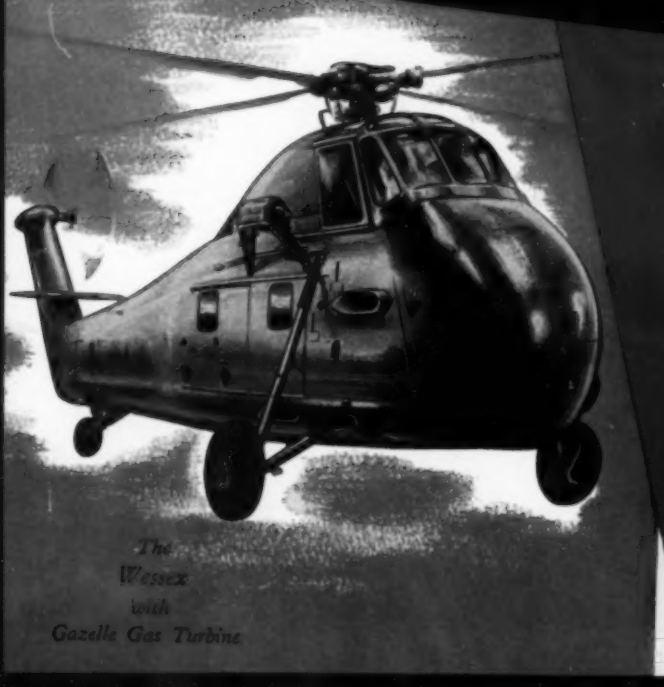
The Widgeon

The Whirlwind with Alvis Leonides Major Engine

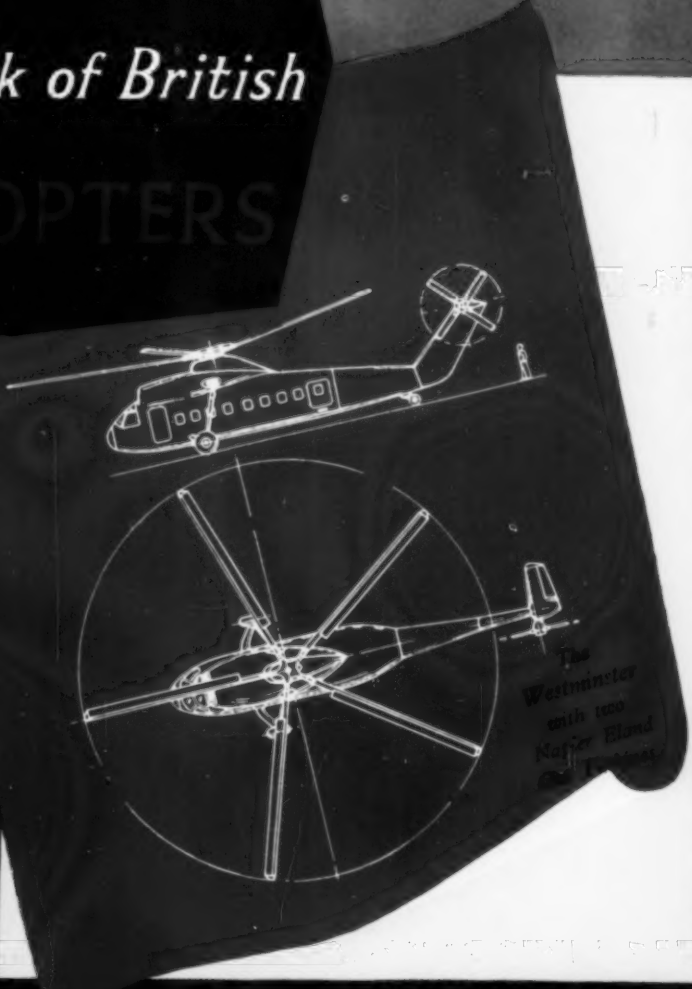
WESTLAND

The Hallmark of British

HELICOPTERS



The Wessex with Gazelle Gas Turbine



The Westminster with two Napier Eland Gas Turbines

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For a quarter century Lockheed aeroplanes have set world standards for speed, range, economy and passenger preference. Today, a Lockheed aeroplane (military) is the world's fastest jet: a Lockheed transport (Constellation types) is a world favourite: and Lockheed is flying propjet engines on a variety of transport aeroplanes (C-130 Hercules in production at the Georgia Division and Military Propjet Super Constellations).

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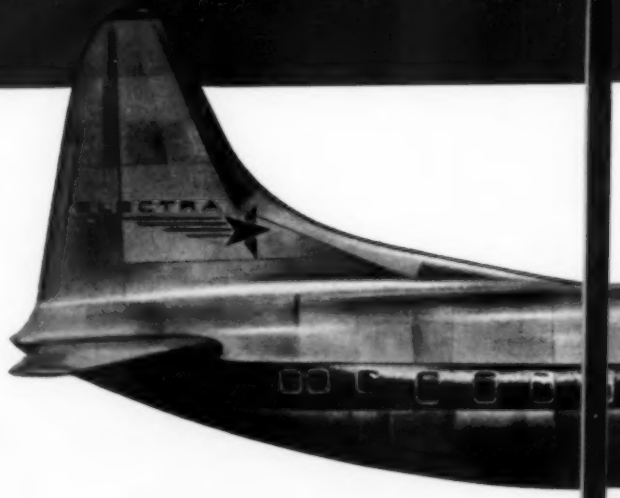
No wonder 129 Electras have already been ordered by American Airlines, Braniff International Airways, Eastern Air Lines, KLM Royal Dutch Airlines, National Airlines, Western Air Lines.

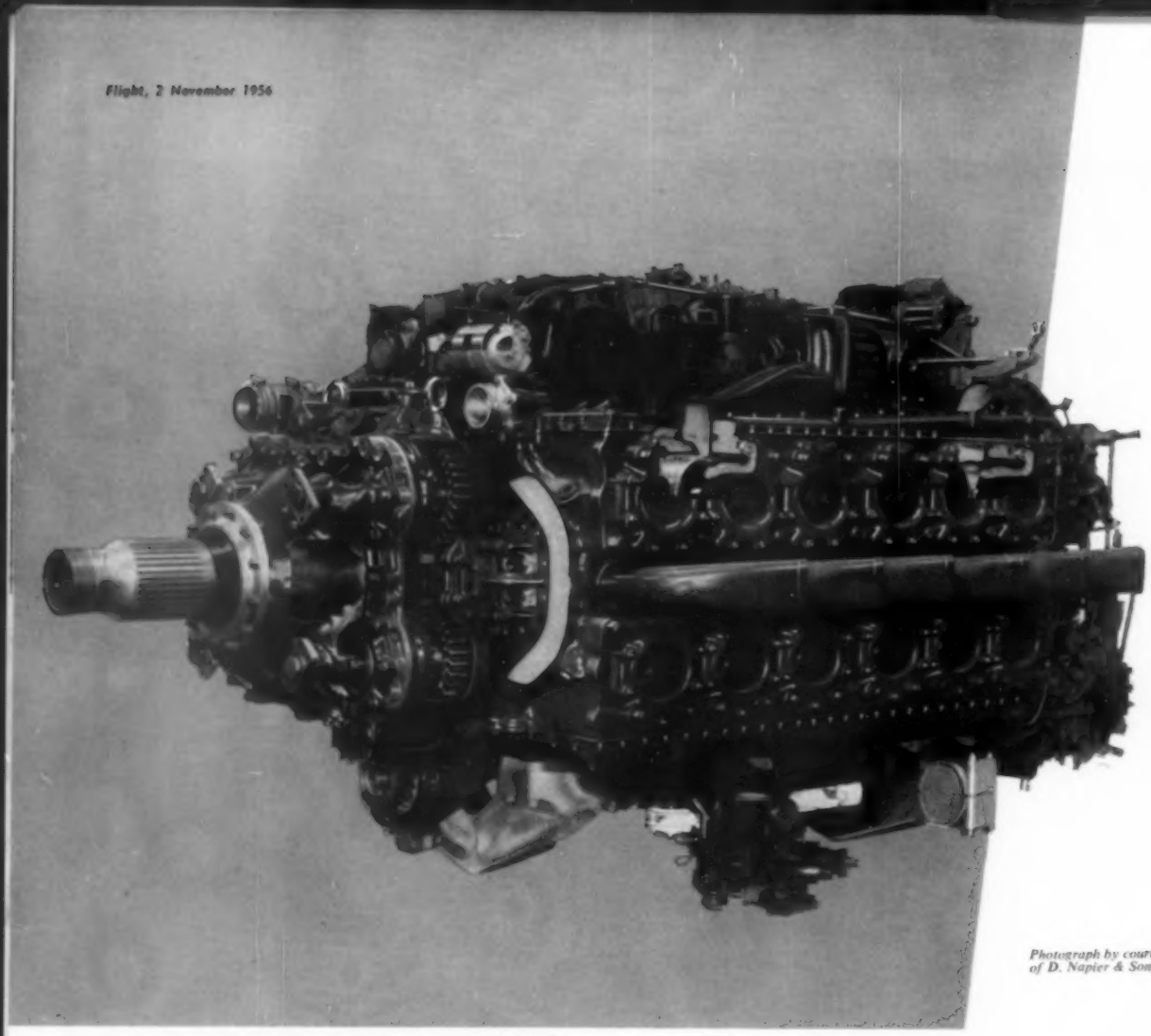


*Powered by propjet engines, in service on C-130 Hercules. Built by Allison Division of General Motors.

LOCKHEED AIRCRAFT CORPORATION, CALIFORNIA DIVISION, BURBANK, CALIFORNIA, U. S. A. / *Look to Lockheed for Leadership!*

reliability

ELECTRA



Photograph by courtesy of D. Napier & Son.

ON JUNE 12th, 1944...

. . . the significant buzz of the 'doodlebug' was heard for the first time over London's East End. Serious problem though this uncanny missile was, the R.A.F. soon had its measure. During the following months thousands were shot down by pilots of 435 m.p.h. Hawker Tempests.

One of the main factors in the success of this operation was the Tempests' high speed (it was the R.A.F.'s first 400-plus fighter) attained with the powerful Napier Sabre engine—a 24-cylinder water-cooled 'H' design. In its final form the Sabre exceeded 3000 b.h.p. and had the lowest specific weight of any piston engine in existence—what a remarkable contrast its performance makes with the first motor to power an aeroplane successfully! From the Wright engine's reluctant 12 b.h.p. to the Sabre's willing 3055 b.h.p., from 14 lb./b.h.p. to 83 lb./b.h.p. and from 3.4 b.h.p./litre to 83 b.h.p./litre it was a period of magnificent achievement.

Yet in spite of rapid advances in design the limitations of conventional power-units above 3000 b.h.p. were becoming apparent. The ultimate development of the piston engine was approaching bringing with it the close of another great age in the progress of power. On May 15th, 1941, the Gloster-Whittle jet flew us into a new era. And what an era of speed it is!

Consider the rapid development of jet propulsion. It is only a few years since the 'early days' yet already air speeds have been attained which open up new fields of endeavour. And way ahead of all this development, Esso Research reaches into the future to provide the fuels and lubricants the new pioneers will need.

It pays to consult

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ESSO PETROLEUM COMPANY LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1
AVIATION TECHNICAL SERVICE, RELIANCE 1261

Helicopters of the World . . .

(Above and right) Bell Model 200 (XV-3).

(continued from page 708)

for armament totalling some 4,000 lb in weight and including dipping, sonar and "lightweight homing weapons."

One of the major problems to be faced in using A.S.W. helicopters is that of crew fatigue during long periods of ocean search in all weathers, which is far more arduous than anything done with rotary-wing aircraft so far. Bell have designed their own autopilot to fill this need, and its characteristics have been matched with the requirements of dunking sonar (sonobuoy) apparatus. The system is, in conception, simple. Pitch and roll are stabilized conventionally by a vertical gyro and a rate gyro in combination. The unique feature is that it is the helicopter control system, and not the fuselage, which is stabilized. This permits rapid variations in c.g. (as might follow the dropping of heavy weapons) without effect on flight path and without the need for any re-trimming. Pilot control of the pitch and roll channels is accomplished by simple manual movement of the cyclic-pitch stick. Directional heading is controlled by a G-2 gyro compass integrated with the autopilot. Changes in heading can be made in two ways. In hovering flight, the HSL can be yawed by the application of pedal pressure, the pedal force governing the rate of yaw. In forward flight, an automatically co-ordinated turn can be made by depressing a button on the cyclic stick and establishing the desired angle of bank with stick movement. Once on the new heading, the pilot recovers from the turn and re-engagement of the button ensures that the new course will be maintained. Collective pitch, and thus altitude, in forward flight is maintained by a pressure-sensing servo which varies collective pitch as a function of pressure altitude related to reference altitude. At any time, the pilot can override any commands or displacements imposed by the autopilot simply by applying a moderate force to the primary controls; this is made possible by slip clutches between the servos and the system.

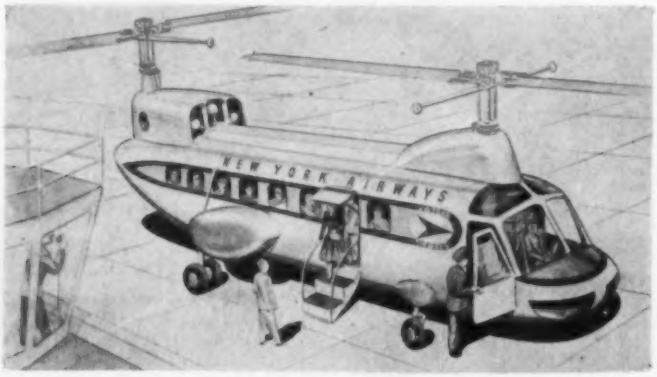
● Rotor diam., 51ft 6in; overall length, 70ft; max. speed at s.l., 132 m.p.h.

Model 200 This convertiplane is officially known as the XV-3. Of tilting-rotor type and powered by a Pratt and Whitney R-985 engine, it has been built to an order placed in 1951. By August last it was reported to have flown with rotor shaft forward angles of up to 15 deg; power requirements at speeds up to 80 kt, it was said, were low, and autorotational descents from 500ft had shown good power-off characteristics.

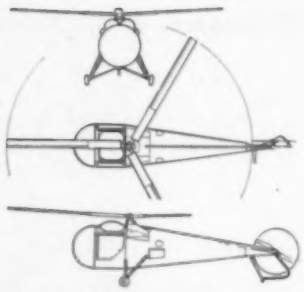
The twin three-bladed rotors are mounted near the tips of the relatively small wing, with the axes of the rotor masts vertical for "helicopter" operation. After a certain speed is reached the masts are tilted forwards through about 90 deg, so that the rotors are then acting as propellers. During conversion (which requires between 10 and 15 seconds) the lift load is transferred to the wing, and after conversion a transmission gear-change, similar to a car over-drive, is used to reduce rotor speed and thereby to attain improved high-speed performance. It is claimed that there will be no abrupt changes in flight characteristics during conversion and that the pilot will retain full control at all times. A makers' announcement states that not only is there no loss of height during conversion, but that the operation can be performed while the aircraft is maintaining a steady climb. In case of engine failure, power-off conversion back to helicopter configuration can be made so that an autorotational landing is possible.

The following remarks by the makers are worthy of record: "The tilting-rotor type convertiplane, capable of vertical take-off and landing coupled with considerable operational radius, contains the element of surprise because of its speed. Speed also enables troops to be moved safer by decreasing the time the transport is subjected to enemy fire when approaching the objective, and makes possible more round trips per vehicle in any given period. In its present configuration, the XV-3 is a four-place observation-reconnaissance aircraft, or a two-place (pilot, medical attendant) evacuation-rescue craft with litter accommodation for two patients. The XV-3 is suitable for transporting men, equipment and supplies within the combat zone in addition to its primary missions of observation and reconnaissance, with delivery to the point of tactical use.

"Commercially, the convertiplane's advantages are apparent. Economically speaking, the helicopter's future lies in passenger and cargo flights up to 150 miles radius, the convertiplane from 100 to 750 miles, leaving fixed-wing aircraft with the balance. And the market is there for the convertiplane. For instance, nearly 28 million persons annually take inter-city plane, train or bus trips of between 150 and 600 miles, which is roughly the convertiplane's optimum area of operation.



(Left) Bell D216. (Below) Bensen B-7M.



(Left and right) Brantly B-2.

The Department of Commerce's Air Co-ordinating Committee recently agreed and predicted that convertiplanes should be operating on inter-city scheduled flight bases in roughly ten years."

● Rotor diam., 25ft; max. length, 30ft; max. speed (estimated), 160 m.p.h. at 2,500ft.

D216 So designated is a project for a 25-passenger commercial helicopter, powered by three gas turbines, and depicted on page 721. Cruising speed is expected to be at least 120 m.p.h. and maximum payload would vary between 6,000 and 8,000 lb. A direct operating cost in the vicinity of 10 cents per available seat is forecast.

BENSEN AIRCRAFT CORP.

Box 2725, Raleigh-Durham Airport, Raleigh, N.C. (Raleigh 8798)

B-7M Gyro-copter Newest of the Bensen ultra-light series the Gyro-copter is a single-seater, powered by a four-cylinder Nelson engine of 40 h.p. On one U.S. gallon of petrol it is stated to have a range of 20 miles. The complete machine is to be marketed at about $1,800, or plans for home construction will be available at $25 a set.

For the following details we are indebted to *American Helicopter*: "Since the Gyro-copter is still in its infancy, the full extent of its potential accomplishments is not yet known. To date, however [May 1956], its lifting capacity is 250 lb, and its endurance with a six gallon tank is two hours, the range being 120 miles. As yet, the Gyro-copter has not been pushed to its top speed; but it was clocked at 75 m.p.h. at partial power. Although it does not hover in the strict sense of the word, it can maintain level flight at 19 m.p.h. and can get in and out of a spot some 100×100ft. Whenever winds exceed 19 m.p.h., it can make vertical take-offs and landings like a regular helicopter. The estimated ceiling of the Gyro-copter is 12,000ft. The Gyro-copter has a free-wheeling rotor, which always spins in 'autorotation' independently from the engine, and thus produces no torque on the fuselage. This eliminates the tail rotor, shafting, gear boxes, clutches and other expensive components, makes the machine lighter and reduces its maintenance requirements comparable to those of a motor scooter."

● Rotor diam., 20ft; fuselage length, 8ft 7in; empty weight, 185 lb; normal gross weight, 420 lb; cruising speed, 60 m.p.h.; max. speed, 75 m.p.h.; min. level speed at s.l., 15 m.p.h.; take-off speed at s.l., 20 m.p.h., landing speed at s.l., 7 m.p.h.; take-off run in calm air, 100 yd; range, 120 miles; service ceiling, 12,500ft; max. rate of climb, 950ft/min.

BRANTLY HELICOPTER CORP.

24 Maplewood Avenue, Philadelphia 44, Penn. (Germantown 8-0114)

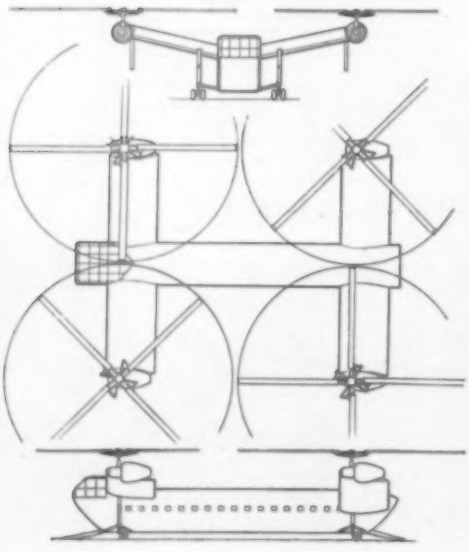
B-2 Two prototypes of the B-2 have been built, and the second will undergo C.A.A. flight evaluation tests for certification for civil use. The fuselage is of stressed-skin construction. The nose section is wholly transparent and two Plexiglas bubbles on top of the cabin increase headroom for the two occupants. Conventional cyclic-stick and rudder pedals are provided on both sides of the cabin, but there is at present only one collective-pitch lever. Provision is being made for a removable collective-pitch lever on the left side for use in pilot-training. The engine is a modified Lycoming O-340-A1A. In order to eliminate the complications of the cooling fan an induction cooling system has been developed utilizing the velocity of the exhaust gases. The drive shaft from the engine is connected to a clutch, which also serves as the flywheel. The clutch is engaged by the action of 96 steel balls which are housed in an annular ring sloping outwards and downwards. As the balls move outward due to centrifugal force, they are forced downward against the pressure plate, engaging the clutch. A flexible coupling transmits the torque to the main gear through a conventional free-wheel unit. A maker's description reads: "The rotor blades have two flapping hinges, with the outer hinge being coincident with the lag hinge. The inboard blade has a symmetrical section with a 29 per cent thickness ratio and an effective chord of 8.84in. It is set at an angle of incidence which is 4 per cent greater than the outboard blade which has an NACA 0012 section with an 8in chord. The inboard flapping hinge is offset a distance of 2.67in from the hub, thereby providing a large hub moment with cyclic control movement giving excellent control response and a large c.g. travel. The second flapping hinge relieves the flapping stresses in the blade. Damping in the plane of rotation is provided by the use of synthetic rubber buffers at the blade stops."

● Rotor diam., 23ft 8in; fuselage length, 21ft 1in; empty weight, 938 lb; gross weight, 1,550 lb; cruising speed at 4,000ft, 100 m.p.h. (indicated); max. speed, over 120 m.p.h.; rate of climb at s.l., over 1,000ft/min; rate of descent in autorotation at s.l., 1,400ft/min.

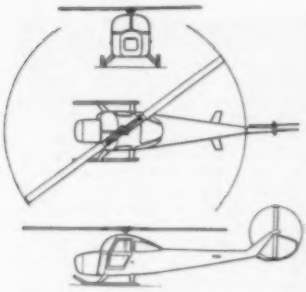
CONVERTAWINGS, INC.

Zahns Airport, Amityville, N.Y. (Amityville 4-4762)

Model A Quadrotor This flying test-bed made its first free flights in March this year, and the makers claim that its successful performance has "provided conclusive proof that the Quadrotor configuration,



(Left) Convertawings Model E Quadrotor. (Below) Model A Quadrotor.



(Above and right) Cessna CH-1.

Helicopters of the World . . .

(Below) de Lackner Aerocycle.

using a simplified rotor and control system in a compact design, is workable, and provides the means for a basic improvement in the helicopter." They add that control is obtained by a differential thrust between the rotors. Complete elimination of cyclic-pitch control and rotor hinge mechanisms is said to produce powerful damped control about all axes. The four-rotor configuration is claimed to confer weight saving, good handling qualities, safer control, reduced vulnerability, drive simplification and compactness. It is also asserted that it provides naturally for multiple pod-mounted powerplants and auxiliary aerofoils without adding structure. The airframe can be economically constructed and maintained by utilizing small duplicate, constant-section components. The identical blades are only one-half as long as on an equivalent single rotor; blade droop is reduced by over 65 per cent, with a corresponding reduction in necessary height and ground-handling problems. The fuselage is free of powerplants, improving safety and comfort, and allowing flexible use of its full volume.

The flying test-bed is powered by two 90 h.p. Continental C-90 engines connected to the rotor drive system by multiple V-belts. Since the four-rotor system relies for its control on equal r.p.m. of all the rotors, the rotors are interconnected by shafting and transmission cases, and since the configuration requires only differential thrust between the rotors it has been possible to eliminate the conventional cyclic-pitch control system. The controls are, however, arranged so that they appear and function exactly as they would in a small single-rotor, single-engine helicopter.

● Rotor diam., 19.4ft; gross weight, 2,200 lb.

Model E This designation distinguishes a project for a massive Quadrotor helicopter of 42,000 lb gross weight, to carry a payload of 10,900 lb, having a range of 300 statute miles and a maximum forward speed of 173 m.p.h. Four Wright R-1820 engines are specified.

Convertawings are also studying the application of the Quadrotor concept to a large flying crane which can be easily disassembled for transport. This would be of cruciform layout, with a two-blade rotor at the end of each arm and with a "driver's cab" between the two forward arms.

(Above) Goodyear GA-400R. (Right) Doman LZ5-2 (stripped configuration).

CESSNA AIRCRAFT CO. INC.

5800 Pawnee Road, Wichita 15, Kansas. (Murray 6-6681)

CH-1 Bearing the U.S. Army designation YH-41, this very clean-lined high-performance helicopter is being offered for military and civil use. The makers claim that through the use of an aerodynamically clean rotor assembly and a streamlined fuselage, and the fitting of a supercharged Continental FSO-470A engine, the machine has the highest C.A.A.-certificated performance of all helicopters. Metal construction is used throughout. The primary structure of the main part of the fuselage is a double-skinned platform, the top of which serves as the floor for the cabin. This section houses the fuel cells and the lower control assemblies, and supports the main rotor transmission, the engine mounting and the landing gear. The support structure for the wind shield and windows also serves as a structural tie between the front and rear parts of the fuselage. The two main-rotor blades are attached to the hubs by flexible L-section hinges of steel sheet, permitting continuously varying pitch of the blades without recourse to pitch-change bearings. The attaching members are made from four sheets of stainless steel formed into L-shaped angles and nested one above the other. Forward mounting of the engine allows a 360 deg field of view for the passenger compartment, which seats four people. Alternatively, the CH-1 can carry pilot and passenger and over 500 lb of freight for ranges up to 100 miles; two stretcher patients and an attendant are another optional load. The skid-type undercarriage uses stainless-steel tension straps in the attaching structure. On normal landings the action is very stiff but on hard landings the excess energy is absorbed by plastic deformation of the stainless-steel straps. Stretching of the links gives a new angular position to the landing gear struts but does not otherwise affect operation. The tension straps can be used until successive hard landings displace the gear to the point of introducing ground-clearance problems. Clip-on wheels are provided for ground handling.

● Rotor diam., 35ft; fuselage length, 32ft 11in; empty weight, 1,975 lb; gross weight, 3,000 lb;

(Left) Gyrodyne XRON-1.

Helicopters of the World . . .

max. speed at s.l., 122 m.p.h.; cruising speed, 100-120 m.p.h.; rate of climb at s.l., 1,000ft/min; max. C.A.A.-certified operating altitude at max. weight, 11,000ft; hovering ceiling at max. weight at 95 deg F, 8,600ft; hovering ceiling out of ground effect at max. weight, 6,000ft; range, 290 miles.

CH-1 (Boundary Layer Control) A CH-1 has been adapted for boundary-layer control and was the first helicopter so equipped. The BLC system is intended to delay the onset of retreating-blade stall—at present a serious factor militating against the attainment of higher speeds by helicopters.

DE LACKNER HELICOPTERS, INC.

14 N. Bleecker Street, Mount Vernon, N.Y.

Aerocycle This platform lifting device has been ordered, to the extent of twelve experimental models, by the U.S. Army. A one-man affair, it has a 44 h.p. outboard engine and its salient features can be studied in the photograph. Control resembles that of a motor-cycle, the machine being guided by the passenger leaning in the desired direction. The U.S. Army has announced that the Aerocycles will be put through tests to ascertain their potentiality on an atomic battlefield. Initial tests have shown that soldiers without previous flying experience become proficient operators of the Aerocycle in twenty minutes. All that is required is a sense of balance and good reflex action.

DOMAN HELICOPTERS, INC.

Danbury, Connecticut.
(Pioneer 3-5521)

LZ5-2 The foregoing is the designation of the present standard civil model of the Doman helicopter; in the U.S. Army it is known as the YH-31. The rotor system is unconventional in that inclination of the rotor tip-path plane with respect to the fuselage is accomplished by gimbal-mounting the rotor hub and rotating it with a constant-velocity driving system. The rotor retains dynamic balance in all flight attitudes, ensuring low vibration. There are no blade-flapping hinges, drag hinges or hinge dampers, and bearings subject to centrifugal loads with oscillating motion are reduced to a minimum. The rotor incorporates reduction gearing as an integral part of the assembly. All moving parts are contained in a common housing which precludes contamination from weather and foreign matter. The blades are of plastic-bonded birch wood and resistance to abrasion from sand, rain or hail is provided by a sheath of solid nylon over the leading edge. The tail rotor is a miniature copy of the main rotor.

An eight-seater, the LZ5-2 is powered with a supercharged Lycoming SO-580-A1A engine delivering 400 h.p. for take-off. The cabin is unusually spacious and large doors open to the full cabin width of 7ft. The standard undercarriage is of quadricycle type, but either skids or floats can be fitted.

● Rotor diam., 48ft; fuselage length, 38ft; empty weight (standard), 3,250 lb; empty weight (stripped), 2,950 lb; gross weight, 5,200 lb; max. cruising speed, 99 m.p.h.; speed for best range, 80 m.p.h.; hovering ceiling in ground effect, 4,000ft; service ceiling at 5,200 lb, 10,500ft; range with 73 gal of fuel (10 per cent reserve), 230 miles; range with 115 gal (10 per cent reserve), 379 miles; rate of climb at s.l., 850ft/min.

GOODYEAR AIRCRAFT CORP.

Akron 15, Ohio.

GA-400R Gizmo The Gizmo has been developed primarily "for any purpose requiring transportation of one man up to 60 knots. The airframe is of welded tubing and carries parallel aluminium skids. Power is supplied by a 2-cylinder Marine and Manufacturing Big Twin engine of 31 h.p. (this is of the outboard type), and the rotor is driven through a belt and pulley system with a 10:1 reduction from the engine. A centrifugal clutch is claimed to provide smooth starting and immediate free-wheeling upon loss of power. The rotor blades are of laminated wood mounted in a steel hub underslung from a "teetering" hinge. The two-bladed tail rotor is of formed aluminium sheet and provides directional control through rudder cables operating its collective pitch mechanism. The makers state: "The GA-400R is capable of hovering manoeuvres, pattern flight, steep turns, high speed, forward flight, rolling pull-outs, and other similar functions." Employment of the Gizmo as a trainer is foreseen by the manufacturers.

● Rotor diam., 18ft; fuselage length, 15ft; empty weight, 235 lb; gross weight, 435 lb; fuel capacity, 3.2 gal; estimated max. speed at s.l., 69 m.p.h.; cruising speed, 46 m.p.h.; endurance at cruising speed, 45 min; vertical rate of climb, 500ft/min; hovering ceiling, 6,000ft; service ceiling, 12,000ft. (Performance figures are estimated.)

GYRODYNE CO. OF AMERICA, INC.

Flowerfield, St. James, L.I., N.Y.
(St. James 2-6366)

XRON-1 Rotorcycle Another American ultra-light one-man helicopter is the Rotorcycle, weighing less than 500 lb fully loaded. Intended applications are observation, liaison and "small unit tactical manoeuvres." Outcome of a U.S. Navy design competition of 1953, the Rotorcycle has co-axial rotors and can be folded into a small package for transport. The basic design will accommodate engines in the 40-75 h.p. range. The present engine is a Nelson H-59 of 40 h.p. A design feature of special interest is the use of small drag brakes on the rotor tips which turn the fuselage by unbalancing the torques of the rotors.

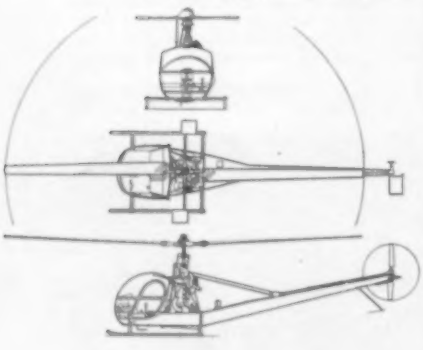
● Rotor diam., 15ft; fuselage length, 10ft 5in; gross weight, under 500 lb.

HILLER HELICOPTERS

1350 Willow Road, Palo Alto, Calif.
(Davenport 5-3241)

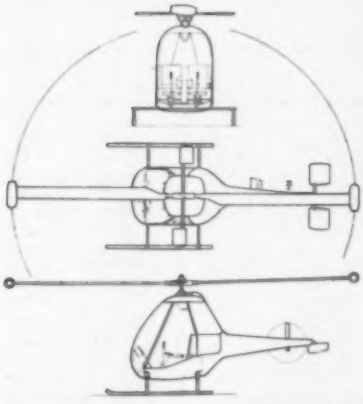
Model 12-C Known in the U.S. Army as the H-23C, the Model 12-C is now being offered for civilian use at a price of $47,750. Essentially it resembles the familiar 12-B but incorporates a number of improvements. "The Hiller Rotormatic control system," the makers state, "now incorporates two outstanding improvements contributing to greater safety and ease of control. The Hiller 12-C has a redesigned main rotor hub incorporating

(Below and right) Hiller Model 12-C.



(Above and left) Hiller HJ-1 (H-32).

(Right) Hiller Flying Platform.



expanded main rotor and control rotor tilt stops, thus improving its controllability and manoeuvrability in turbulent air. Redesign of the cyclic control scissors provides large self-aligning ball trunnions covered by rubberized dust protectors." A bubble-type canopy is now fitted and the instrument panel is much more compact than on earlier Hillers. The engine is a Franklin 6V4-200-C33 of 200 h.p., and the makers state that a supercharged installation will be available to improve altitude performance. A three-seater, the Model 12-C is adaptable for ambulance work and for operation from water. A rescue net can be slung from the skid undercarriage and external loads up to 494 lb can be carried with a quick-release mechanism.

● Rotor diam., 35ft; fuselage length, 27.8ft; weight empty, 1,642 lb; gross weight, 2,500 lb; max. speed, 84 m.p.h.; cruising speed (max. range), 71 m.p.h.; range, 138 miles (250 miles with auxiliary tank); service ceiling, 10,100ft; hovering ceiling in ground effect, 2,600ft.

Model 12-D Features of this model include a 250 h.p. Lycoming engine; an entirely new transmission system, designed for 1,000 hr between overhauls, and for powers up to 280 h.p.; and an entirely new tail rotor assembly. Official designation is H-23D.

Model HJ-1 The U.S. Army's first operational ramjet helicopter the HJ-1 (H-32) is being built in limited quantities for tests. The U.S. Navy and Marines have three machines of the same type, designated HOE-1, and the C.A.A. and manufacturer's own name for the aircraft is Hornet. The rotor is driven by two Hiller 8RJ2B ramjets, one at each rotor-blade tip. These units are easily removable, have no moving parts, weigh 13 lb, and develop about 45 h.p. each. For starting there is a small 1 h.p. petrol engine, which spins the rotor up to 50 r.p.m. When the rotor has attained 550 r.p.m. the helicopter can leave the ground. The rotor blades have solid extruded aluminium leading edges and built-up magnesium trailing edges.

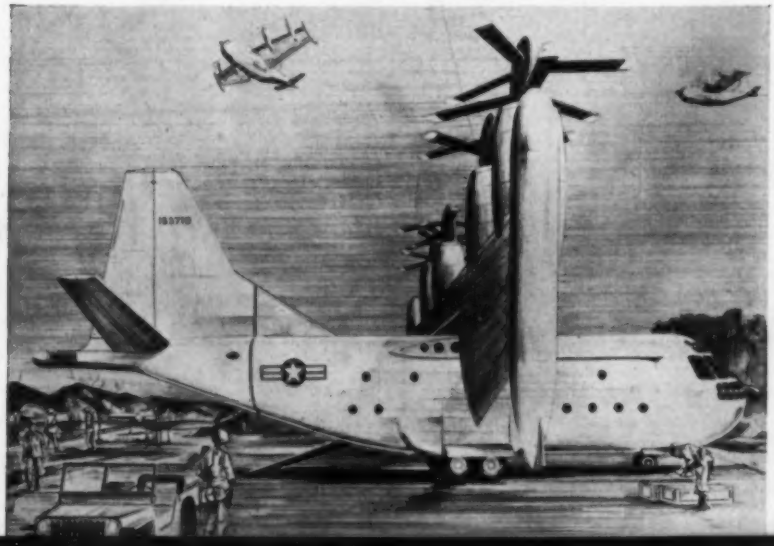
● Rotor diam., 35ft; overall length 23ft 8in; empty weight, 544 lb; gross weight, 1,080 lb; cruising speed, 69 m.p.h.; rate of climb at s.l., 700ft/min; service ceiling, 6,900ft; range 28 miles.

XROE-1 This designation applies to a forthcoming ultra-light helicopter for the U.S. Marine Corps. It will be of conventional layout, with tail rotor, and will be powered by a Nelson engine. A point of interest is that its specified duties will be observation, liaison and—an imaginative application this—escape and evasion.

Flying Platform Of this unique vehicle the makers write: "In April 1955 the Office of Naval Research and Hiller helicopters unveiled the revolutionary one-man Flying Platform. Still a research tool, the Flying Platform is now undergoing modification and additional tests to further explore the principle involved. The Flying Platform is almost literally a flying carpet which the pilot controls by body-balance instead of using manual or mechanical flight controls. Conventional controls and instruments are virtually eliminated. Directional flight is achieved merely by leaning in the direction one wishes to go. Man's dream of flying has always included the idea of flight so simple as to be instinctive. The concept of the Flying Platform, stabilized and controlled by the same instinctive reactions a person uses to stand upright, more closely approximates this ideal than any aircraft ever built.

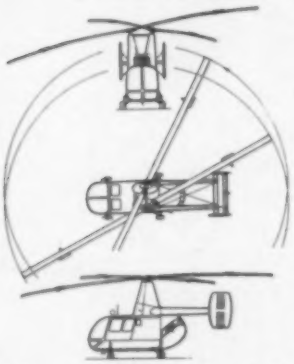
"The Platform also uses a new principle of lift and propulsion called the ducted fan. It is the first ducted fan type of VTO aircraft to fly carrying a man. Variations of this principle have been flown while tethered, but this is the first such vehicle to achieve piloted free flight. Besides definitely establishing the feasibility of radically simplified flight, it also appears reasonable that variations on the Flying Platform design, both larger for long-range missions, and smaller for short-range missions, could be successful. The primary advantage of such aircraft would be the extreme ease of flying and learning to fly, and their low cost. Maintenance would be relatively simple because of the inherent simplicity of the aircraft."

Large Convertiplane Illustrated on this page is a proposal for what is described by Hiller as "a large transport propelloplane," submitted as the result of a study made for the U.S. Army through the Office of Naval Research. The machine would use the principle of tilting wing and propeller units for vertical take-off, landing and hovering, and in aeroplane configuration should achieve high performance.



Hiller proposal for large convertiplane.

Helicopters of the World . . .



(Above and right) Kaman K-600 (HOK-1).

KAMAN AIRCRAFT CORP.

Bloomfield, Conn.
(Hartford Chapel 2-4481)

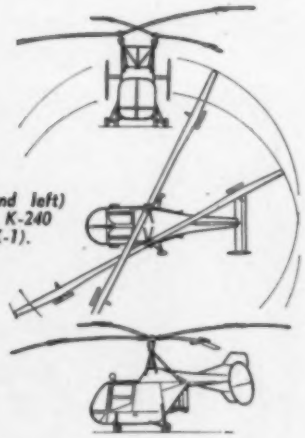
Model K-240 Known in the U.S. Navy and Marine Corps as the HTK-1, this helicopter is principally a trainer but is quickly adaptable as an ambulance. The contra-rotating intermeshing rotors have a servo-flap system of control; they are driven by a Lycoming O-435 engine. The blades are of solid spruce and are attached to the hub only by lag hinges, for the servo flap system dispenses with the ordinary blade-pitch change. The servo flaps actually cause the blades to twist. The fuselage boom carries a large horizontal tailplane, which is connected to the collective-pitch control for maximum stability. As an ambulance the HTK-1 carries a stretcher case and attendant or two sitting cases in the fuselage and two additional stretcher cases in external litters.

Flight of October 19, 1956, described how an automatic hovering device, which enables the machine to maintain position above a fixed point without pilot assistance, has been demonstrated on an HTK-1. Horizontal control was by photo-electric cell sensing and vertical control by a sensitive barometric device. At a height of 1,000ft, the helicopter stayed within a 20ft circle in winds of between 20 and 30 m.p.h. for periods up to 20 minutes. The main practical application foreseen for this development is in ground surveying and topographic mapping; the helicopter, it is considered by the makers, could provide an elevated surveying target for long-range work.

● Rotor diam., 41ft; max. length, 41ft; empty weight, 2,300 lb; gross weight, 3,000 lb; max. speed at s.l., 86 m.p.h.; hovering ceiling in ground effect, 4,500ft; normal still-air range, 120 miles.

Model K-600 In its military form (HOK-1) the K-600 is in quantity production for the U.S. Navy and Marine Corps. Like the Model K-240, it has twin two-blade intermeshing rotors but differs in several respects, notably in that it has twin tail-booms. The engine is a Pratt and Whitney R-1340-28 of 600 h.p., mounted at the rear end of the fuselage at an angle of 35 deg. Blade pitch, as on the Model K-240, is controlled by servo flaps. In U.S. Marine Corps service HOK-1s are intended for cargo carrying, casualty evacuation, search and rescue, reconnaissance and personnel transport. Normally seats for four are provided but in the ambulance rôle the HOK-1 can take two stretcher patients and one sitting patient or an orderly in addition to the pilot. A recent development is a "bear-paw" type undercarriage, quickly attachable to the normal wheeled gear. The bear-paws make possible operation from snow, sand and mud by providing a large bearing area. The fitments themselves are small, light and can be carried on the aircraft for quick installation in the field.

Another recent development is a radio-controlled version for military use. Three such machines have been developed to a U.S. Navy and Army joint contract. At the time the order was placed Radio Corporation of America became interested in the possibilities of mounting in the machine the back-pack television camera and transmitter which they had developed for the U.S. Army Signal Corps. The potentialities of this line of development are manifold and significant. The helicopter can be guided from a control station on the ground or in another aircraft, or by what is described as a "memory" system, presumably a programmed control. These three systems can also be used in combination, control being handed over from one to another as required. Special applications which have already been tested include simulated battlefield surveillance, using the television camera and transmitter;



(Right and left) Kaman K-240 (HTK-1).

Automatic and Instantaneous V.H.F. Direction Finding

MARCONI TYPE AD 210C

EQUIPMENT PROVIDES

- Visual, automatically sensed, bearing indication of signals in the 100-156 Mc/s band.
- Presentation of bearings on an 8-inch meter in a combined display and control unit.
- Selection of five-spot frequencies.
- Remote control for on/off switching and frequency selection, by D.C. over distances up to 5 miles.
- Facilities for repeater display units up to 500 ft. from the main display and control units.
- Facilities for use in Marconi Automatic Fixer System.
- Comprehensive monitoring facilities.
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More than forty Airlines and twenty Air Forces fit Marconi air radio equipment and Marconi airport installations are in use throughout the world.

(ABOVE)
The local equipment cabinet of the VHF Automatic Direction Finder Type AD 210C. The four main units are withdrawable on runners for easy access.

(RIGHT)
The Display and Control Unit allows instant selection of one of five frequencies.

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Airport and Aircraft Radio Systems

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX.

LA 16

Both the 'Bristol' Type 173 Twin Rotor Helicopter and the 'Bristol' Type 171 Sycamore Helicopter use LAYRUB as the main drive between engines and rotors. The Layrub Couplings use rubber trunnion blocks as the main driving elements. There are no metal-to-metal contacts; the drive being fully cushioned. No lubrication is required, therefore, little maintenance. Write us for full details of these shafts made specially to the requirements of the aircraft industry.
LAYCOCK ENGINEERING LTD. SHEFFIELD 8.
Layrub
TRANSMISSION at its best

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the laying of telephone cable; and the transporting and automatic unloading of cargo in inaccessible areas. Still and cine cameras can also be installed to make permanent records of battle situations. These tactical applications are obviously attractive, but still further developments are possible. The robot helicopter could be used in conjunction with television to seek out target areas and drop smoke-bombs as visual markers for artillery fire. The machines could be made to lay smoke-screens to obscure troop movements, or lay and detonate lines of explosives through mine fields, thus clearing a path for troops and vehicles; and yet another adaptation, the company claims, might be the use of robot helicopters for hunting and destroying enemy tanks and vehicles.

● Rotor diam., 47ft; overall length, 47ft; empty weight, 4,290 lb; gross weight, 5,482 lb (5,934 lb overload); max. speed at 8,000ft, 115 m.p.h.; hovering ceiling in ground effect, 13,700ft; normal still-air range, 290 miles.

HOK-1 (with XT53 gas turbine) First flight tests of the Lycoming XT53 free-turbine for helicopter use will be made with a HOK-1. The turbine is mounted above the fuselage, thus increasing the internal space. (In 1951 Kaman flew the world's first turbine-powered helicopter, and during 1954 a twin-turbine HTK was being flown.)

KELLETT AIRCRAFT CORP.

P.O. Box 468, Camden 1, New Jersey. (Merchantville 8-4800)

KH-15 Known as Stable Mabel, the KH-15 is described as a variable-stability helicopter test-bed, "in which significant rotor parameters can be modified." It is powered by two Reaction Motors XLR32 hydrogen peroxide rocket motors, mounted at the tips of the two-blade rotor. Its principal function, however, is to flight-test a new gyro stabilizing system and to demonstrate positive dynamic stability without loss of control throughout the speed range. "Of prime importance," state the makers, "is the fact that the principles of the stabilizer are not peculiar to the KH-15 but are applicable to any type helicopter, whether it be single rotor, tandem, side-by-side, co-axial, or synchropter and the system is entirely independent of the type of propulsion system. Although the ultimate in helicopter stability and control has never been realized, these flight tests indicate that the goal is being approached and the new gyro stabilizer is evidently a key to the problem."

KH-17A Another flying test-bed, developed under the auspices of the U.S. Navy for flight investigation of a partially loaded rotor system, the KH-17A is a modified Kellett KD-1B autogyro originally built in 1939. In the nose is a 275 h.p. Jacobs engine and on each wing a 140 h.p. Lycoming.

McDONNELL AIRCRAFT CORP.

St. Louis 3, Missouri (Pershing 1-2121)

XV-1 A speed of 200 m.p.h. is claimed to have been attained by one of these convertiplanes. Two examples are flying, and development is sponsored by the Department of the Army under the direction of the U.S.A.F. Air Research and Development Command. The development programme provides "both a prototype aircraft for Army liaison/reconnaissance type missions as well as research aircraft to explore this principle for possible use in larger troop and cargo carrying aircraft." The rotor is driven by McDonnell-developed pressure-jets at the tip of each of the three blades. The pusher propeller is powered by a Continental R-975-19 piston engine, which also drives compressors for the supply of air to the pressure jets during "helicopter" flight. The machine carries three passengers or two stretcher patients and a medical attendant in addition to the pilot. The pilot and co-pilot/observer sit in tandem and dual controls can be fitted. The exit doors are jettisonable. A tailplane carrying tabs is mounted between the two tail booms. Two non-retracting skids comprise the landing gear, and the installation is unusual in that energy is absorbed during a hard landing by yielding, replaceable, stainless-steel straps. (A similar arrangement is used on the Cessna CH-1.)

● Span, 26ft; overall length, 30ft.

NAGLER HELICOPTER COMPANY

Westchester County Airport, White Plains, N.Y.

NH-160 This ultra-light, single-seat helicopter, with co-axial rotors, is under development. An unorthodox feature is the wide—6ft—separation of the two rotors. Power is supplied by a 72 h.p. McCulloch engine, as developed for drone aircraft.

NH-161 A proposed development of the NH-160, with a McCulloch engine of 150 h.p., this machine would have a gross weight of 1,200 lb and a maximum speed of 120 h.p. at sea level. The lower rotor would be of high-speed type, fully shrouded, and would have three blades, whereas the upper would have two.

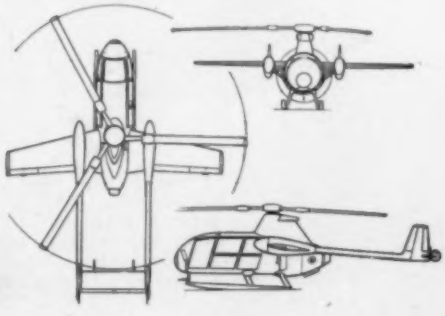
OMEGA AIRCRAFT CORPORATION

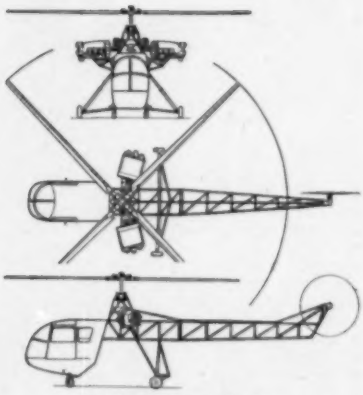
Municipal Airport, New Bedford, Massachusetts. (Wyman 3-4270)

SB-12 The design of this unusual helicopter is the work of Bernard W. Sznycer, who, in 1951, obtained a Canadian certificate of airworthiness for his model SGV1. Mr. Sznycer has departed from the trend towards higher cruising speed and expensive streamlined monocoque structures, concentrating instead on achievement of reliability coupled with satisfactory payload; low initial price and low cost of maintenance; sufficient power reserve to hover at 5,000ft; quick loading and unloading, and rapid conversions from passenger version to a cargo carrier or ambulance; and reduced vulnerability of expensive components in case of crash landings. A maker's statement runs: " . . . an 800 lb payload dictated a powerplant of 400 h.p., which, to achieve reliability, was broken in two 200 h.p. units; but at the same time, the price of two small engines even with the addition of extra clutches, pinions, etc., is still much below a single unit of corresponding power. . . . Another consideration of greater reliability was striven for while reducing development costs . . . This paradoxical statement is due to designing all parts subjected to oscillatory loading for infinite life, thereby avoiding very expensive and time-consuming fatigue bench-testing, wherever the weight or space consideration permitted. True, the very low permissible oscillatory stress

Kellett KH-15.

(Left and below) McDonnell XV-1.





(Above) Omega SB-12.

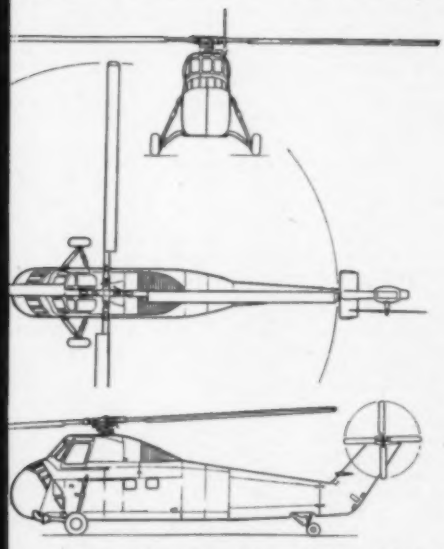
(Left) Sikorsky S-55. (Below) Sikorsky S-56 (HR2S).

Helicopters of the World . . .

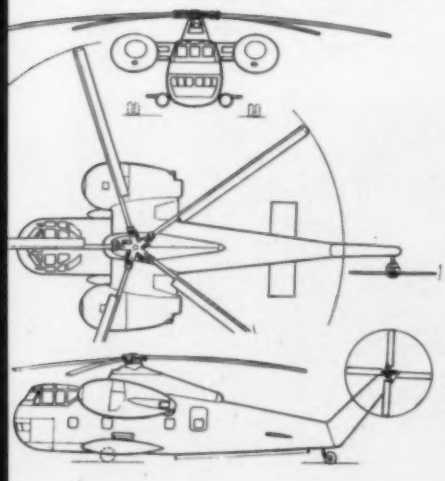
levels selected resulted in an increase of weight empty. But so far, the penalty is not too severe. . . ."

The main transmission splits into upper (pinion) and lower (gear) sections by removing twenty-four elastic stop nuts. Three identical pinions and housings are used, even though two pinions take 200 h.p. each and the third only 30 h.p. Part of the speed reduction between the engine and rotor is taken in a Goodyear belt drive. The present engines—Franklin 6A4-200-C6s—permit the carriage of four persons plus pilot and a 320 lb freight load. With larger engines a payload equivalent to eight passengers can be lifted.

● Rotor diam., 39ft; fuselage length, 36ft;



(Top) Sikorsky S-58 (HSS-1). (Centre) Sikorsky S-58. (Below) Sikorsky S-56.



empty weight, 2,950 lb; gross weight, 4,300 lb; max. speed at s.l., 103 m.p.h.; cruising speed, 86 m.p.h.; max. rate of climb at s.l., 1,170ft/min; hovering ceiling with ground effect, 5,900ft; service ceiling, 11,600ft; range (standard tanks), 160 miles.

PIASECKI AIRCRAFT CORP.

Island Road, International Airport, Philadelphia 42, Pa. (SA 7-9750)

Current Projects It was announced last July that this Corporation is working on eleven prime contracts for the Armed Services of the U.S.A. and has additional proposals under evaluation. Contracts are in hand for a design for a VTOL aircraft "eliminating the helicopter-type rotor"; the Sea Bat—a drone helicopter for special military purposes; the design of a flying crane helicopter several times larger than any now flying; a mine countermeasures system; and the design, construction and testing of a low-maintenance helicopter rotor.

SIKORSKY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORP.

Bridgeport 1, Conn. (Edison 4-1071)

S-55 This very famous and successful helicopter—already briefly described under Great Britain (Westland)—is now nearing the end of its production run. Many versions are serving the U.S.A.F. and U.S. Army under the basic designation H-19, the U.S. Coastguard and U.S. Navy as the HO4S, and the Marine Corps as the HRS. Engines generally fitted are the Pratt and Whitney R-1340 and Wright R-1820. The data below apply to the ten-passenger H-19B (Wright R-1300).

● Rotor diam., 53ft; overall length, 62ft 7in; empty weight, 5,045 lb; normal gross weight, 7,500 lb; max. permissible weight, 7,900 lb; max. speed at s.l., 110 m.p.h.; hovering ceiling in ground effect, 8,500ft; normal range, 395 miles.

S-56 This large twin-engined helicopter is being built for the U.S. Marine Corps under the designation HR2S and for the Army as the H-37A. It is the first helicopter in the world to have a retractable undercarriage. The two engines are Pratt and Whitney R-2800 Double Wasps, mounted outboard of the fuselage on stub wings, and power is transmitted from both to the five-blade main rotor and to the tail rotor. Each rotor is arranged to fold. The fuselage has nose-opening doors and will carry two combat assault squads, that is, about 26 fully equipped men. The production version differs from the prototype in having twin main wheels, improved cooling, a slab tailplane and faired rotor head. Speed is between 150 and 160 m.p.h. and gross weight between 28,000 and 30,000 lb. Developed models are to have Allison turboprops.

S-58 The U.S. Navy, Army and Marine Corps designations of this helicopter are, respectively, HSS, H-34 and HUS. Compared with the S-55, the S-58 is roughly 50 per cent larger, twice as powerful, and is capable of operating with more than twice as much useful load. It is, however, essentially simple and conventional, and has reached a very high state of development for military and civil use.

The engine is a Wright (Lycoming-built) single-row Cyclone C9 (military version, R-1820-84), delivering 1,525 h.p. for take-off. It is installed in the extreme nose at an inclination of about 30 deg, and is covered by two nonstructural clamshell-type nose doors. From the rear of the engine the inclined drive is taken up to the intermediate gearbox, and to the main rotor and tail-rotor gearbox. The S-58 transmission employs 25 per cent fewer parts than are used in the transmission of the S-55. Accessory drives from the transmission are provided for a generator and its cooling blower, for the hydraulic pumps for the primary servo controls and the hoist, and for the rotor tachometer. The clutch is of a new, hydraulic pattern, and it permits protracted engine-running at any r.p.m. with the rotor disengaged.

The main rotor employs four, fully interchangeable, all-metal blades. Great emphasis has been placed upon reducing complexity, and in providing for long life and easy maintenance. The blades, which are of symmetrical N.A.C.A. 0012 section, are free to move about vertical and horizontal axes.

Fuselage structure is a conventional semi-monocoque box, forming an unrestricted hold 13ft 3in long, 5ft 3in wide and 6ft high from floor to ceiling. The flight deck is superimposed on the remainder of the structure, and the rear part of

Helicopters of the World . . .

the pilots' compartment can readily be removed to provide access to the main gearbox and flight controls. The rear 10ft of the fuselage (which is swept up to form a stabilizing fin) can be folded forward against the remainder of the structure, thus reducing the hull length to about 37ft (this feature was originally incorporated to ease stowage problems aboard carriers with the HSS-1). There is also a small fixed, stabilizing tailplane.

● Rotor diam., 56ft; fuselage length, 47ft 2in; empty weight (with standard equipment), 7,530 lb; max. weight, 13,000 lb; max. speed at s.l., 132 m.p.h.; cruising speed, 104 m.p.h.; max. climb at s.l. at rated power, 1,100ft/min; vertical s.l. climb on take-off power, 450ft/min; hovering ceiling at take-off power, without ground effect, 2,500ft (with ground effect, 7,000ft); range with normal reserves, 270 st. miles (ferry range with auxiliary fuel, over 972 st. miles).

S-59 Bearing the U.S. Army designation H-39, the S-59 is a development of the earlier S-52, engined with a Turbomeca Artouste 2 shaft turbine. In August 1954 a machine of the same type set up a speed record of 156 m.p.h. over a 3-km course, and later in the same year attained a height of 24,500ft.

● Rotor diam., 35ft; overall length, 41ft 7in; empty weight, 2,200 lb; gross weight, 3,625 lb; hovering ceiling in ground effect, 8,500ft; range, 288 miles.

TRANSCENDENTAL AIRCRAFT CORP.

Glen Riddle, Pa.
(Valleybrook 2926)

Model 1-G This is a single-seat convertiplane with rotors mounted at the wing-tips. These are tilted forward after take-off to propel the machine as an aeroplane. The engine is a Lycoming 0-290-A of 160 h.p., and rotor transmission is by way of spanwise shafts to bevel gearing at the wing-tips. A two-speed gear is incorporated in the rotor drive to give the required r.p.m. for vertical and forward flight.

● Wing span, 21ft; fuselage length, 26ft; empty weight, 1,450 lb; gross weight, 1,750 lb; estimated max. speed as helicopter, 120 m.p.h., as aeroplane, 160 m.p.h.; ceiling as aeroplane, 5,000ft.

VERTOL AIRCRAFT CORP.

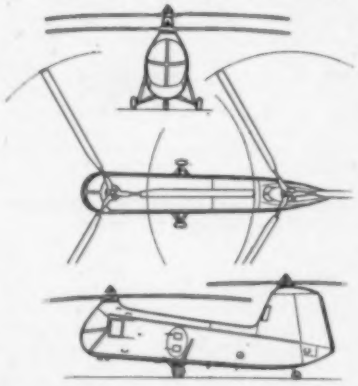
Morton, Pa.
(Swarthmore 6-4000)

Model PD-18 Known to the U.S. Navy as the HUP Retriever and to the Army as the H-25 Army Mule, the PD-18 is a single-engined tandem-rotor helicopter. The rotors are driven by a single Continental

Sikorsky S-59 (H-39).

R-975 engine of 550 h.p. or—in the HUP-4—by a Wright R-1300 of 700 h.p. Typically the machine is a six-seater, with a fuselage of all-metal stressed-skin construction. Dual hydraulic controls are fitted, and there is a large rescue hatch (48in long by 26in wide) at the forward end of the cabin in the right-hand side of the floor, near the pilot's seat. An hydraulic hoist permits personnel, stretchers, etc., up to 400 lb in weight to be lifted through the hatch. The engine is fan-cooled and readily removable as a power package, including accessories and lubricating system. The HUP-2 has a Sperry automatic pilot as the primary controller.

(Below) Vertol PD-18 (HUP-2) Retriever.



● Rotor diam., 35ft; overall length, 56ft 11in; empty weight, 3,900/4,100 lb; normal gross weight, 5,750 lb; max. gross weight, 6,100 lb; max. speed at s.l., 108 m.p.h.; hovering ceiling in ground effect, 7,000ft; range, 490 miles.

Model PH-42 Another successful Vertol twin-rotor single-engined helicopter, the PH-42 is known in the U.S.A.F., U.S. Army and R.C.A.F. as the H-21 Work Horse. The type is also being supplied to France under the same designation. The fuselage is of all-metal, stressed-skin construction, and the cockpit has side-by-side seating with complete dual controls and an automatic pilot. Cabin dimensions are 20ft long × 5ft 6in wide × 5ft 6in high, giving a capacity of 615 cu ft. The main door is on the left side at the aft end, and there is a rescue door, with a swinging boom-like hoist, behind the pilot at the forward end. Complete winterization equipment, including cabin heating and insulation, is standard. The H-21B is an assault transport for the U.S.A.F., with seats for 20 troops, a larger rear door and extra windows. The H-21C is a supply transport for the U.S. Army, though it is capable of being used alternatively as a troop carrier. Rotor-blade ground clearance is sufficient to allow vehicles and personnel to approach the machine in safety. Even with engine idling there is a clearance of 13ft 4in. Powerplant is the Wright

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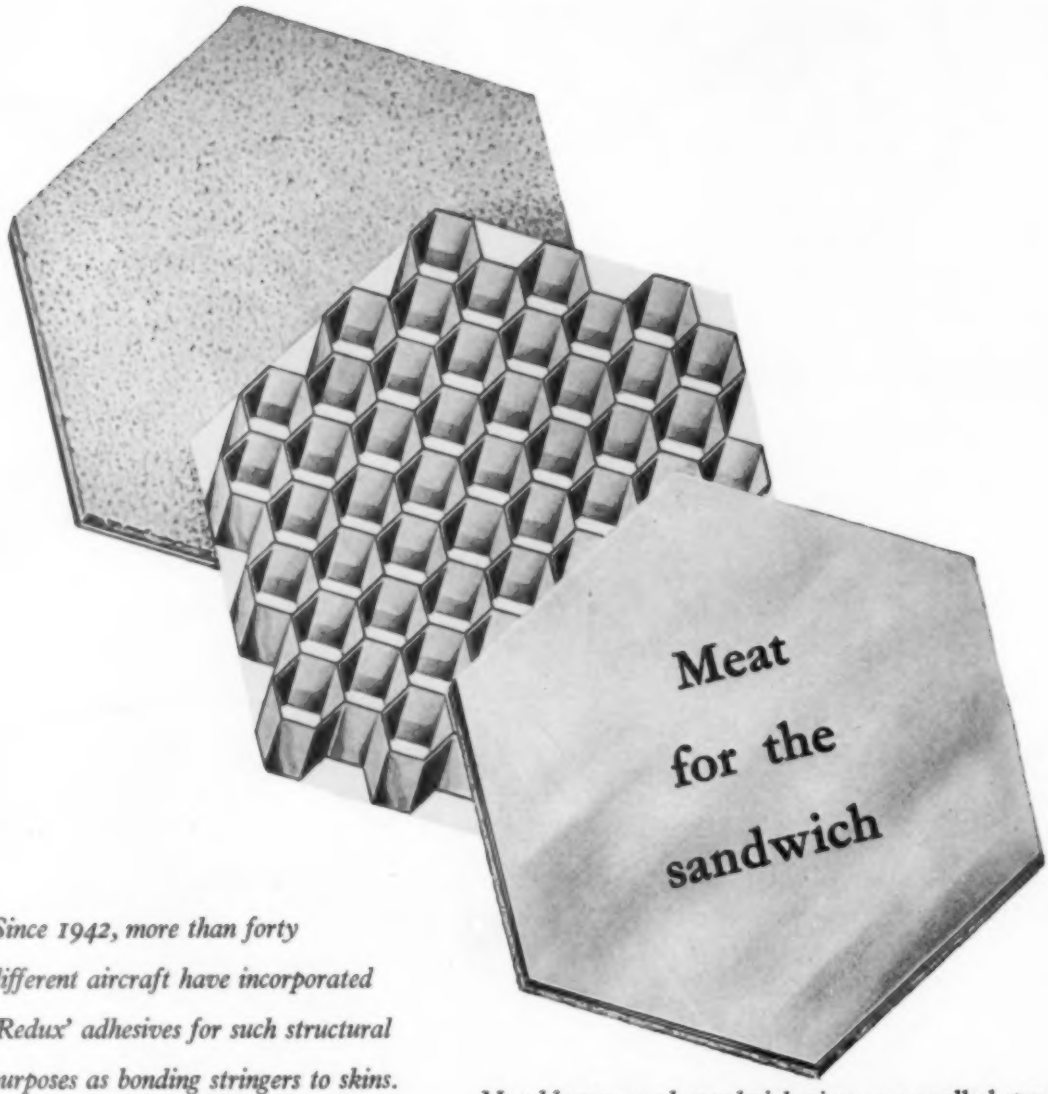

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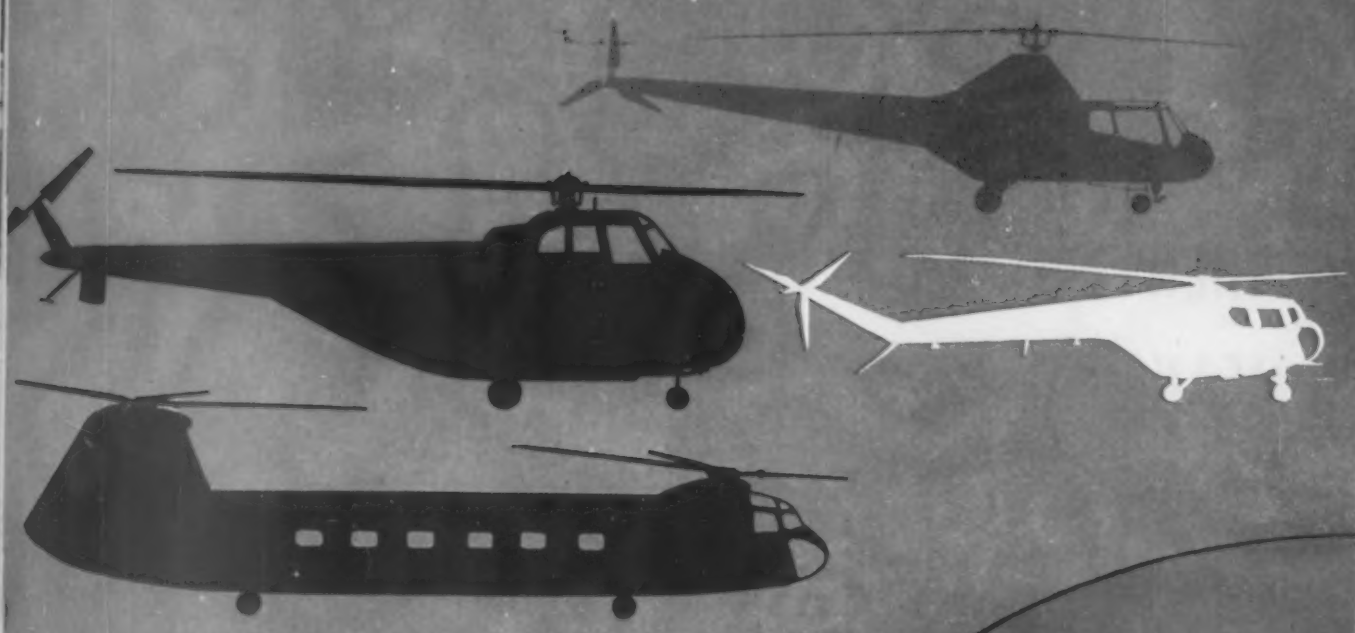

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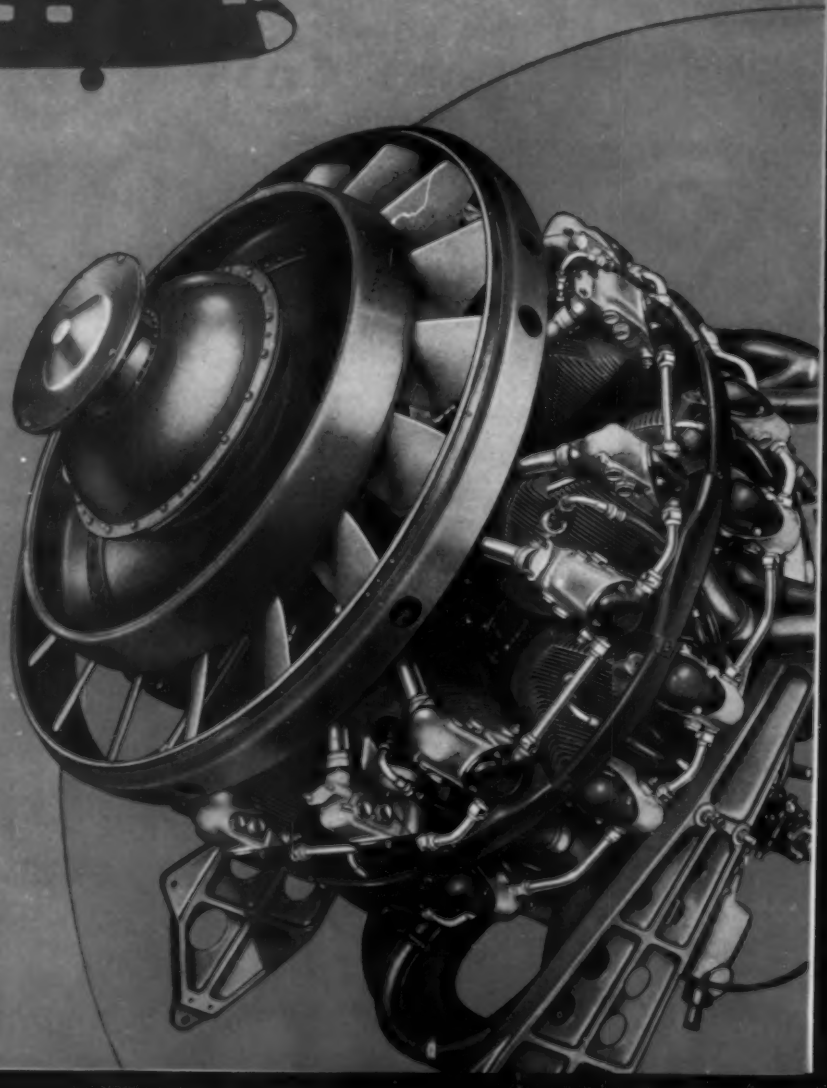

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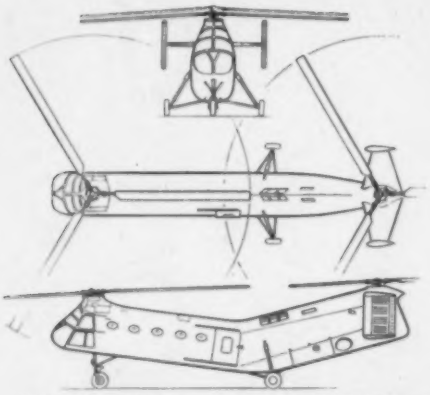


(Above and right) Vertol PH-42 (H-21) Work Horse.

Helicopters of the World . . .

R-1820 of some 1,425 h.p. A projected civil version has been abandoned.

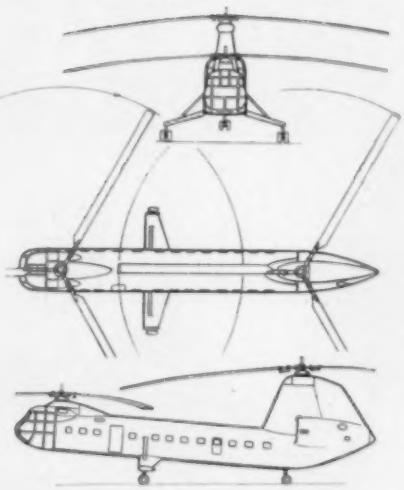
● Rotor diam., 44ft; overall length, 86ft 4in; empty weight, 8,600 lb; gross weight, 13,300 lb; overload gross weight, 15,000 lb; max. speed at s.l., 130 m.p.h.; rate of climb at s.l., 1,080ft/min; range, 375 miles.

Model PH-42 (with T58 gas turbines) A contract has been awarded by the Navy Bureau of Aeronautics and the U.S. Army to equip two standard H-21C helicopters with two General Electric T58 gas turbines. The payload will be increased by 40 per cent and a cruising speed of about 150 m.p.h. will be possible. Hovering ceiling will be raised by several thousand pounds and an extended warm-up period will not be required. On an emergency mission, in fact, the turbine-powered machine could be in the air in less than half the time required by the standard piston-engined version. The two T58s will occupy less space than the single piston engine and will weigh only half as much.

YH-16A The YH-16A is a turbine-powered development of the YH-16 and precursor of a proposed higher powered production version, known as the YH-16B. Flight tests have demonstrated the ability to maintain height with normal load with one of the two Allison YT38 turbines shut down. The machine was built as part of a heavy-cargo helicopter programme calling for machines with a 5/7-ton capacity. Alternatively, up to 40 passengers can be carried and the YH-16B will be developed to carry 69 troops. During December last year the YH-16A attained a speed of 166 m.p.h.

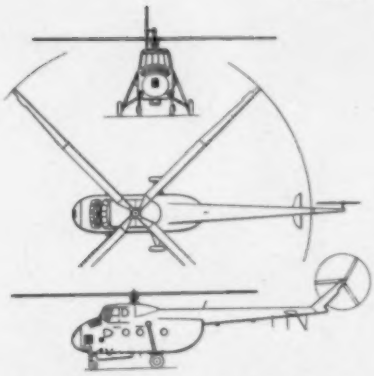
● Rotor diam., 82ft; overall length, 134ft; gross weight, over 32,000 lb; service ceiling, over 18,000ft.

VTOL Aircraft A contract has been placed by the Office of Naval Research for a VTOL research aircraft of the tilt-wing type. The single turboprop unit will be geared to two rotor-propellers mounted far outboard on the wing. A skid-type undercarriage will be fitted.



(Right) Vertol YH-16. (Below) Vertol YH-16A

Left and right, Mi-4.



Helicopters of the World . . .

SOVIET UNION

MILLA

Mi-1 This 3/5-seater helicopter has been in service since 1951 for postal work, communications, ambulance, rescue, liaison and the air inspection of high-voltage cross-country transmission lines, etc. The fuselage is a steel tube structure to which is attached the conical semi-monocoque tail boom. In the normal arrangement a bench for three passengers is provided behind the pilot. Radio equipment is installed in the extreme nose and a radio altimeter is generally fitted. The engine is an ASZ-21 seven-cylinder radial with fan cooling and developing a maximum of 575 h.p. The main rotor blades are of mixed construction.

A point of particular interest is the suitability of the Mi-1 for flights in icing conditions. Anti-freezing liquid is carried in a tank under the rotor pylon and is continuously sprayed over the main and tail-rotor blades and windscreen.

A more detailed description of the aircraft, with sectional drawings, appeared in *Flight* of April 20 last.

● Main rotor diam., 48ft 5in; gross weight, 4,938 lb; max. speed, 125 m.p.h.

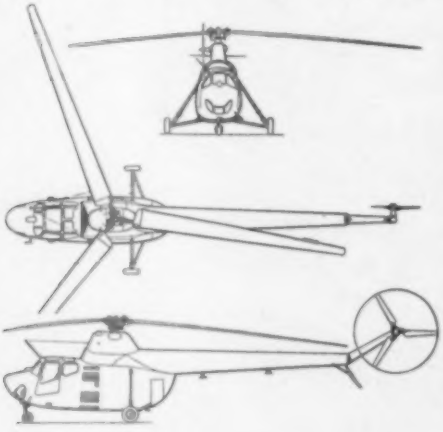
Mi-4 This helicopter bears the same relationship to the Mi-1 as does the Westland Whirlwind to the Dragonfly. It is powered with a 1,000 h.p. ASH-62 radial mounted in the nose and driving the large four-bladed rotor via an inclined shaft. A particularly valuable feature of this helicopter is that—in certain versions at least—large clamshell doors are fitted at the rear of the capacious interior, which can seat ten fully equipped troops. The Mi-4 was first seen in 1953 and is now fully operational in all parts of the Communist world, including Arctic and Antarctic exploratory areas. It is the holder of several world records, typical of which are an ascent to 19,472ft with 4,400 lb payload and an average of 116.3 m.p.h. over a 310.7-miles circuit.

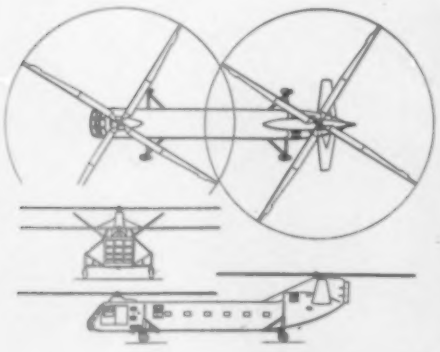
● Rotor diam., 58ft; gross weight, 12,000 lb approx.; max. speed, 125 m.p.h. approx.

YAKOVLEV

Yak-24 A successful and already widely used large transport helicopter, the Yak-24 is fitted with two ASH-62 radial engines driving tandem interlinked counter-rotating rotors almost identical in design with that of the Mi-4. The fuselage is built up as a metal framework, with unstressed metal skinning at the front and rear and fabric covering over the middle portion. The two pilots and radio operator are seated in the glazed nose, with access to the forward power compartment immediately behind, around which is a narrow passage leading to the unobstructed main cabin. The latter can accommodate as many as 40 persons, or three small M-20 Army utility cars, access for bulky cargo or vehicles being provided by a loading ramp at the rear end.

● Rotor diam., 58ft; gross weight, 23,000 lb approx.; max. speed, 130 m.p.h. approx.





Left, Mi-1. Below and lower left, Yak-24.

FRANCE

SUD-EST AVIATION

37 Boulvd. de Montmorency, Paris XVI. (BAG. 84-00)

S.E.3130 Alouette II A turbine-driven helicopter seating up to five people, the Alouette II is now in production with a single Turboméca Artouste II. The cabin enclosure is of notably clean design and almost completely transparent; the central and rear fuselage structures are of triangulated steel tubes, the rear fuselage being detachable for transport. The seating arrangement is two in front and three behind, but the machine is readily adaptable for the usual military or civil missions, and in the ambulance rôle can take two stretchers and two sitting cases. The undercarriage is of the skid-*cum*-wheel type. In the centre of the fuselage, forward of and below the Artouste, is the fuel tank of 126 gallons.

● Rotor diam., 33ft; empty weight, 1,818 lb; gross weight, 2,970 lb; max. speed, 112 m.p.h.; cruising speed, 105 m.p.h.; rate of climb, 1,180ft/min; service ceiling, 14,760ft; hovering ceiling with ground effect, 9,800ft.

S.E.3150 Progress with the Alouette II has encouraged the makers to plan a new version, designated S.E.3150, with a covered tail-boom structure. In addition, the cabin has been slightly widened and lengthened, and staggered seats added to accommodate two extra people, bringing the total to seven. The new shape is expected to increase cruising speed by 12 m.p.h.

Left, SM-1 (Polish-built version of the Soviet Mi-1) during a recent demonstration of its hovering ability.

OUEST-AVIATION

105, Avenue Raymond-Poincaré, Paris, 16E.
(Kléber 32-20)

S.O. 1221S Djinn Already in full-scale production, this lightweight two-seat helicopter has now appeared in its developed version. The two-blade metal rotor is driven by tip jets supplied with compressed air by a Turboméca Palouste air generator. No tip-burning is used. Residual thrust from the turbine is blown over the aerodynamic rudder to provide directional control. Skid landing gear, crank-handle manual starting and two-seat cabin are standard; additional items are stretcher carriers, spray bars, radio, electrical systems, extra fuel tanks and suspended load-carrying hook.

Rotor inertia is such that rotor r.p.m. can be brought up to 400, turbine reduced to idling, and a jump start, forward flight and controlled landing be made without difficulty. With two occupants the Djinn landed on the Monch in Switzerland at a height of over 13,000ft. Simplicity of construction and handling, safety provided by high rotor inertia and absence of tail rotor, quick starting, good performance and low operating and first cost are claimed as advantages of the Djinn. At a height of 8,200ft, in an ambient temperature of −15 deg C, the machine can take off at a weight of 1,360 lb—44 lb below maximum weight. It can fly a 69 mile stage, allowing 10 per cent fuel reserve, with a load of 610 lb, including pilot.

In military service the Djinn has been tested as a launching platform for wire-guided anti-tank missiles. Principal military applications are training, liaison and artillery spotting. Performance of the production Djinn has been improved by increased rotor efficiency and structural simplification. Aerofoil-shaped cuffs have been added to cover the blade root structure, which was previously exposed.

● Rotor diameter, 36ft 2in; fuselage length, 17ft 4in; empty weight, 793 lb; military gross weight, 1,755 lb; civil gross weight, 1,670 lb; top speed, 81 m.p.h.; maximum range, with 10 per cent reserve, and 18 gallon extra tank, 156 miles.

Above, S.E. 3130 Alouette II. Upper right, S.E. 3120 Alouette I.

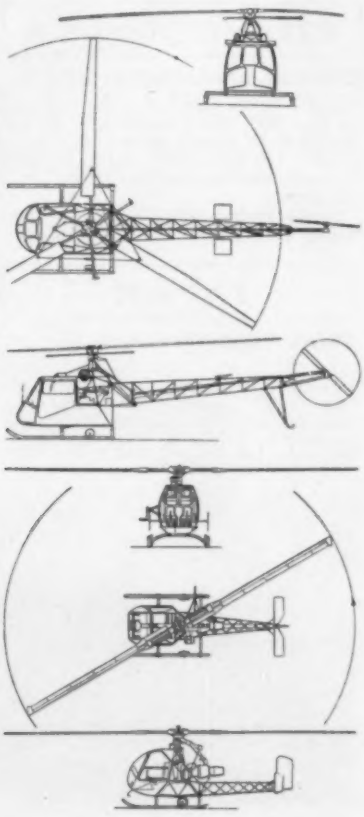
Left and right, S.O. 1221 Djinn.

POLAND

TRANSPORT EQPT. FACTORY

Swidnik, Lublin.

SM-1 The SM-1 single-rotor general-purpose helicopter is the Polish version



Helicopters of the World . . .

Above, HC-2. Right, Kolibrie H-3.

of the Soviet Mi-1, and all parts, except engines, which will be imported from the U.S.S.R., will be Polish-made. Series production is to begin next year. The first SM-1s will be principally used for the training of pilots. The 575-h.p. engine will give a top speed of about 125 m.p.h., ceiling will be about 16,000ft and range 200 miles. The cabin is to be heated and the blades will have de-icing equipment. Next year, an ambulance version will be produced, and an agricultural version is also in view.

BZ-4 Zuk This new "automatically stabilized" helicopter was shown for the first time during the Polish Aviation Day exhibition on August 25 last. A design of B. Zurakowski, who was also responsible for the earlier Polish GIL helicopter, the BZ-4 is powered by a Polish engine. Development is in hand and production is intended. A photograph appears on this page.

Swidnik Projects The Swidnik works are designing a twin-turbine helicopter to carry about twenty passengers. Miniature single-seat helicopters are also in prospect.

CZECHOSLOVAKIA

CENTRAL BOHEMIAN WORKS

HC-2 Powered by a Praga D engine of 80 h.p., this little two-seat helicopter is claimed to fly roughly twenty miles to the gallon. The second seat can be removed to make way for luggage, freight or a stretcher.

Speed (regime unspecified) 80 m.p.h.; ceiling, 10,000ft; "load capacity," 420 lb.

JAPAN

TOKYO KIKAIKA KOGYO CO.

Tokyo.

Yomiuri Y-1 Sponsored by one of the "big three" Japanese newspapers—the *Yomiuri*—this Bell-like two-seater is powered by a Hitachi Jinpu III seven-cylinder radial of 150 h.p.

● Rotor diam., 32.8ft; empty weight, 1,166 lb; gross weight, 1,650 lb; max. speed, 96 m.p.h.; cruising range, 200 miles.

NETHERLANDS

NEDERLANDSE HELICOPTER INDUSTRIE N.V.

Vliegveld Zestienhoven, Rotterdam.

Kolibrie H-3 The H-3 is described by its designer as the prototype of the production version and has been flying since May this year. This machine differs from the original prototype H-2 mainly in having a much cleaner fuselage. The two-blade rotor is turned by tip-mounted ramjets each with its separate fuel supply. In a letter to *Flight* the chief designer writes: "The design offers the operator a utility aircraft that quickly can be changed for different tasks. A second seat can be attached to the left side; the number of tanks can be varied depending on the required range; agricultural equipment, litters, a hook, a closed cabin and other special equipment are being developed by N.H.I. The H-3, having a minimum empty weight of 450 lb, has recently flown under overload conditions at an all-up weight of 1,550 lb. Design a.u.w. is 1,325 lb. Important features are the twin-engined layout with separate fuel supply, the extreme high inertia rotor and a very low disc loading, enabling the pilot to make very fast jumps and to overcome critical situations. The usual dangerous height area does not exist at all. The aircraft has proved to be stable and can be flown a considerable time without touching cyclic, collective and rudder controls. The low operating costs are due to the low initial price and the extreme simplicity. There are fifteen times less parts compared with piston-engined helicopters of equal payload. High fuel consumption is compensated by the high payload/all up weight ratio and the low fuel price as common household kerosine is used. Production of the first series will start in 1956. Export will be possible at the end of 1957."

SPAIN

AEROTECNICA S.A.

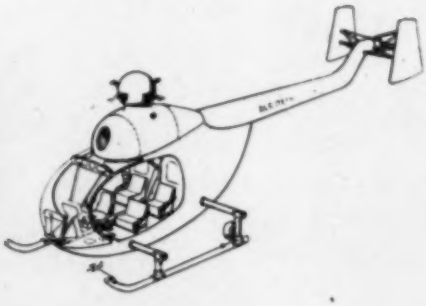
Carrera de San Jeronimo 40, Madrid.

AC-14 Six of these interesting machines are under construction. A Turboméca Artouste II is mounted above the cabin (as was the piston engine of the AC-12), and five passengers will be carried in a shapely soundproofed cabin. Residual thrust will be used in cruising flight to increase forward speed, leaving the movable tail fins to provide all anti-torque and directional control.

A full and exclusive account of Aerotecnica helicopter activities by a member of *Flight's* staff appeared in our issue of February 24 this year.

● Empty weight, 1,210 lb; gross weight, 2,640 lb; max. speed, 109 m.p.h.; cruising speed, 78 m.p.h.; hovering ceiling with ground effect, 11,800ft; hovering ceiling without ground effect, 7,600ft; max. rate of climb, 1,200ft/min; service ceiling, 24,000ft.

Below, Yomiuri Y-1. Above right, BZ-4 Zuk. Lower right, Aerotecnica AC-14.



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105 Ave Raymond Poincaré, Paris 16e

ABERPORTH IN ACTION

A Visit to a Major British Missile Range

LAST week we were permitted to see something of the work under way at the Royal Aircraft Establishment, Aberporth. This establishment has long been known as the chief British centre for guided-missile flight trials, but its necessarily remote location—and, no doubt, Ministry of Supply policy—have so far prevented the establishment from receiving more than local publicity.

The head of the range lies on the Lleyn Peninsula, in Cardiganshire, where rocket firings have been carried out since 1939. Since 1946 very considerable expansion has taken place, and the complete range, which occupies most of Cardigan Bay, is instrumented for experimental firings of both surface- and air-launched missiles.

Air-launched missiles are prepared in the contractors' factories and flown to the range area on their launching aircraft; a proportion of such missiles are also equipped for surface launching. All surface-launched weapons and test vehicles are prepared at Aberporth and, when the booster motors have been added, are tested by missile acceptance officers before going to the launchers. Further comprehensive tests take place with the missile on the launcher; and whenever a target drone is involved these checks are particularly rigorous. Drones comprise Firefly U.8s and other types of radio-controlled aircraft based at Llanbedr, near the northern end of the range area.

As far as possible, the programme for each day is planned in advance so that range time can be precisely allocated, with all the required instrumentation and facilities brought to bear on each firing. The entire range system is monitored from a central control room and emergency stop action can be effected at any moment. Everything fired on the range eventually comes down in Cardigan Bay, where shipping is almost non-existent. Surveillance radar follows all traffic in the area, both on the surface of the sea and in the air, and the dimensions of the range (Caernarvon peninsula is some 80,000 yd to the north) have so far not proved particularly restrictive; in any case, missiles with greater range are fired at the much more extensive facility at Woomera.

Observation posts with kine-theodolites, radars, Döppler sets and other equipment are situated at various points around Aberporth and along the coast. Telemetering, timing and other data are fed to a main instrumentation building at the range-head, range time being governed by a single quartz-controlled master clock. Target drones are prepared at Llanbedr and flown off under local radar control to an appropriate position over Cardigan Bay. Control is then transferred to Aberporth, who fly the drone in the required pattern while the multiple cameras which it carries photograph the miss-distance of the test vehicle or weapon which may be fired at it. Destruction of the target is avoided wherever possible, and Aberporth surveillance then transfers the machine back to Llanbedr, where it is landed.

Should a missile go out of control in the air, special means are taken to ensure that it never leaves the range area. With test vehicles, it is normal practice to fit break-up charges which sever portions of the airframe to create high drag and cause the resulting portions to tumble harmlessly into the sea. Excluding "ironmongery" such as simple sighting rockets, test firings at Aberporth are currently running at the rate of almost 1,000 per year. The following notes concern the principal items of interest which we were allowed to see during our visit.

C.R.P.—The Clausen Rolling Platform is a ship-like object floating in a land-locked basin at the foot of the cliffs below the launching area, where it is approached by a cable railway which can carry the largest missiles on the 11-minute journey from the upper level. The C.P.R. is circular in plan-form and displaces 750 tons. Impulses transmitted from "shore" can induce it to roll and pitch, and varying the water-ballast distribution in the keel can result in sea characteristics exactly equivalent to those of any desired type of warship. On the platform is mounted a large dish radar with associated cameras which can be stabilized either by lock-on or other means. Associated with this radar is a triple launcher which can be constrained to follow the same stabilized bearing and elevation.

An Armstrong Whitworth test vehicle was fired for our benefit from the centre barrel of the launcher. This was the first major firing of the day, and for the first time we heard the "pips" at 2 min, 1 min, 30 sec and 15 sec, and at one-second intervals from ten to zero. At −2 sec the bright flares on the missile were ignited and the launching was smoothly effected at an angle of some 30 deg. There was a vivid, instantaneous impression of light yellow flame from the outward-toed wrap-round boosters. At burn-out the boosters separated and the missile—which was a simple dart, without guidance—was left to fly ballistically, finally to enter the sea many miles out. The thunderous noise of the boosters was reflected from the surrounding hills long after the time of burn-out, and each motor case made a sharp hiss of steam as it entered the water.

R.J.T.V.—Most of the ramjet test vehicles launched in Britain have been fired from Aberporth, and it was from here that one of the N.G.T.E. vehicles—designed and manufactured by Napier—reached its record height before being broken up to prevent it from passing outside the range area. A Bristol test vehicle, however, was fired on the morning of our visit. Before firing, all that could be seen of the device was its pointed nose and the first dozen feet of cylindrical body; an indication that the powerplant was not integral with the body. Launching was carried out conventionally at about 60-deg elevation and, as the wrap-round boosters separated, it was just possible to ascertain the fact that the R.J.T.V. was powered by twin ramjets mounted at the tips of a stubby horizontal wing. The faint exhaust flames continued to be visible until the vehicle entered cloud after two or three seconds' flight.

In this photograph taken recently at Aberporth (an R.T.V. rocket-motor test vehicle) is being refuelled on the launcher. High-test peroxide is the fuel for the sustainer-motor of this particular missile.

Fireflash.—It was announced that a Hawker Hunter would demonstrate low-altitude launching of Fairey Fireflash air-to-air weapons. This missile, which was described in our issue of September 7 (page 437), is in production as an interim training weapon for Fighter Command and forms the main armament of the Swift F.7. It is understood that the Hunter will not normally be armed with the Fireflash, and the Fireflash-Hunter recently demonstrated at Farnborough did not, in fact, bear British Service markings. The Hunter seen at Aberporth, however, was a standard Fighter Command machine with the serial number XF 310.

Watched from the cliff top, some 450ft above the sea, the Hunter's runs were only some 50ft above our position. The first pass was made at a low speed which emphasized the extremely strong cross-wind that was blowing. The wicked-looking black and white Fireflashes were clearly visible under the Hunter's wings. The aircraft then completed the circuit and approached once more on a northerly course, pointing straight out into Cardigan Bay and losing height at full power while working up to Mach 0.9. Directly overhead one of the Fireflashes was fired with a vivid spurt of yellow flame and a fearsome noise from its paired motors. The latter were quickly blown off and the body of the weapon then curved down to ricochet from the sea about 5,000 yd ahead of the aircraft. The aircraft continued to fly straight and level with the remaining Fireflash still in place. (There is no reason to suppose that the Hunter's gunsight was switched on or that the weapon was under any form of guidance.) On the final run the remaining Fireflash was neatly jettisoned, swinging downwards about its rear mounting point and flicking across beneath the aircraft before falling free and striking the sea with the boosters still in place.

English Electric Vehicle.—The final item was the firing, at an acute angle, of an English Electric test vehicle of the type illustrated and described in our issue of September 14 last. The sun had long since set and the dramatic combination of the darkening sky and the high wind made the firing an unforgettable spectacle. The multiple wrap-round boosts were both blinding and deafening, and the tracking flares enabled the flight of the missile to be followed for many miles as it flew straight and level at a very great altitude, finally to become lost to sight behind the distant clouds.

W. T. G.

NEW AIRCRAFT MARKS

IT is now permissible to refer to the Gloster Javelin FAW.5 twin-Sapphire all-weather fighter. Already in production, this aircraft is not superficially different from the FAW.4 (which introduced the all-flying tail). Also in production is the T.3 dual-control variant, which will probably be issued to Javelin squadrons for service as a checking-out and familiarization machine.

Other new marks lately confirmed are Swift F.7, with Fairey Fireflash, and Sea Venom FAW.22, a refined two-seat carrier-based machine with a more powerful engine—presumably the Ghost 105.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Convertiplanes

ALTHOUGH convertiplanes of several types have been flying quite successfully in the U.S.A. for some time past, the true convertiplane (that is, an aircraft which takes off, and lands, as either a helicopter or autogiro, and the rotor of which retracts into the fuselage or wings, so that it flies as a perfectly normal aeroplane for its entire journey) is at present still in the drawing-board stage, even in U.S.A., where the Sikorsky concern are said to be "well advanced" with such a design. There is every reason to believe that this machine, when brought to a successful issue, will prove to be the surviving type of air passenger liner of the future. Sikorsky mentioned the possibilities of an aircraft of this type in his lecture delivered to the Institution of Mechanical Engineers during the summer of last year.

To reduce excessive weight, cost and complication, it is possible that rotor systems of the autogiro type will be used in preference to helicopter rotors. The undoubted advantages of the autogiro principle have never yet been fully realized. Had the system been invented today, instead of over 30 years ago, it would have been hailed as an aeronautical marvel, if only for its utter simplicity, lightness and cheapness as compared to the helicopter. Like many another outstanding invention, its main trouble was that it was invented half a century before its time. For its advantages to have been fully realized, it should have been invented *after* the helicopter, not before. (By this, the writer means the successful helicopter of today, not the several thousand patent-applied-for helicopters over the past 70 to 80 years or so.) Furthermore, in taking-off even a giant air liner, absolute direct helicopter lift is not a *sine quâ non*. The very short take-off run of 50 to 100 yards or so necessitated by the autogiro system is permissible.

In the case of a large fixed-wing aircraft in which auxiliary rotors are used merely for take-off and landing and are stowed for (say) a 5,000-mile non-stop flight, a costly and heavy helicopter system would be utterly out of the question from the airline operators' point of view; and if rotors were used at all, the ultra light, simple and cheap autogiro rotor would be the obvious answer.

Incidentally, the writer took out the first British patent ever to be applied for by a Britisher for an aircraft of this type, as far back as 1938. Its number is 499,632. An extension of patent term was applied for and granted; consequently, notwithstanding its age, it is still operative.

London, S.W.17. E. V. HAMMOND.

Tonnage Preferred

SINCE your publication of Mr. Brown's apparently excellent suggestion [*Flight*, October 12] that aircraft weights and loads should be measured in tons instead of pounds, I have scanned your correspondence columns in vain for evidence of the unanimous support this long-overdue measure might have been expected to receive.

The ton is the commonly accepted unit for measuring vehicle and cargo weights in most forms of transport, and its use in aviation would surely facilitate comparison. Furthermore, the ton is nearly equivalent to the metric ton, enabling approximate conversion to metric system weights to be made without agonizing mental gymnastics. Can it be that the seeming coyness of the aviation world in this matter is due to a desire to soft pedal comparison with those other forms of transport, either because the relative capacity of aviation is at present so small or its charges, particularly for freight, so high?

If air freight is ever to be more than the froth on the body of transport beer it will have to adopt more sensible units than pounds weight. Will you, sir, not encourage this step (and help your struggling readers, not all of whom carry slide rules in their pockets) by quoting tonnages as well as, or instead of, poundages?

Southsea, Hants. TORQUEMADA.

A Rolls-Royce Designer

YOUR recent article on Sir Henry Royce was most interesting; but in my view the brilliance of this great man has rather overshadowed the work of at least one individual who contributed very largely to the prosperity of Rolls-Royce aero engines.

I refer to Mr. A. J. Rowledge. I have been in the engineering industry quite a long time and have had the opportunity of seeing firms from the inside. Frequently the credit for good work does not go to the person mainly responsible for it. Round about 1919 the Napier Lion engine was showing its capabilities; in fact it was so good that most of the high-powered aeroplanes from then onwards utilized it, at the expense of Rolls-Royce business. When some time before 1925 Mr. Rowledge decided to join Rolls-Royce, Rolls-Royce engines took on a new look and one could hardly help noticing that certain points of the new series of engines had things in common with an advanced design of car engine for which Mr. Rowledge was responsible. The "F" engine, which, as most people know, was the forerunner of the Kestrel, can be described as the prototype of all Rolls-Royce aero-engines up to the Griffon, and must have been to a large extent due to the influence of Mr. Rowledge's work.

In passing, it is interesting to note that the world's land speed record is still held by a car driven by engines developed from Mr. Rowledge's 1919 design. The reputation of Sir Henry Royce is secure for all time, but I cannot help feeling that Mr. Rowledge's work has not received full recognition.

Cropston, Leics. R. C. MCLEOD.

In the Queue

MAY I refer to your report "Controlling the Traffic" on page 653 of your October 19 issue? In the last paragraph on that page you have quoted in brackets a reply attributed to Mr. Collins, leading the reader to believe that a 12-second separation can be achieved "between aircraft fitted with Decca and buffers." This gives, unfortunately, a wrong impression and is perhaps misleading to a very marked extent. The general reply to the question of separation standards between aircraft fitted with Decca was that a five-minute longitudinal and a ten-mile lateral separation were being used in experiments with these aircraft so fitted.

Mr. Collins, in his contribution to the panel's reply, was referring to an earlier question raised during the course of Captain Bailey's lecture, when a statement was made by the Decca Radar representative to the effect that trials had been carried out at Dum-Dum airport with Decca-equipped aircraft, and a V.F.R. landing rate had been achieved of 12 sec. Mr. Collins said in jest that if Decca Radar and Decca Navigator could get together and, additionally, if buffers be fitted to the aircraft, perhaps a 12-second separation could be used. It was not, however, a serious proposition at this stage and we had to be content with a five-minute figure.

London, W.1. JOHN K. SUTCLIFFE,
Editor, *Journal of the Guild of Air Traffic Control Officers.*

[Our contributor of course realized—and assumed that readers would too—that Mr. Collins's remark about 12-second separation between aircraft fitted with buffers was not serious; but he regrets any misunderstanding that may have arisen.—Ed.]

FORTHCOMING EVENTS

Nov. 1-2. Institute of Welding; Joint Meeting with the Netherlands Welding Society.
Nov. 2. Helicopter Association: "Development of the Skeeter Helicopter," by T. D. Nisbet, A.R.Ae.S.
Nov. 6. R.Ae.S.: Main Lecture: "London Airport," by Air Marshal Sir John D'Albiac, K.B.E., C.B., D.S.O.
Nov. 7. Air-Britain: National Aviation Photographic Competition.
Nov. 7. Kronfeld Club: Discussion on Aircraft/Car Fuel Wager.
Nov. 9. Blackpool and Fylde Aeronautical Society and Blackpool and Fylde Aero Club: Dinner Dance.
Nov. 9-10. Agricultural Aviation Show, Palmerston North, New Zealand.
Nov. 10. Society of Licensed Aircraft Engineers: All-day Meeting: "Non Destructive Testing and Inspection."
Nov. 13. Institute of Transport: Anniversary Luncheon.
Nov. 13. R.Ae.S.: Section Lecture: "Air Conditioning of Aircraft," by Dr. E. W. Still, F.R.Ae.S.
Nov. 14. Kronfeld Club: "Navigation Across the Tasman Sea in 1930," by Francis Chichester.
Nov. 16. Institute of Navigation: "Navigational Aspects of Turbo-prop Operations over the North Atlantic," by J. E. D. Williams.
Nov. 20. R.Ae.S.: Section Lecture: "C. of A. Flight Testing," by D. P. Davies.

R.Ae.S. Branch Fixtures (to November 21).

Nov. 5, *Belfast*, "Gyroscope," by C. B. Flindt; *Halton*, Film Show. Nov. 6, *Boscombe Down*, "High Speed Flight Problems," by R. F. Creasey. Nov. 7, *Luton*, "The Prestwick Pioneer," by N. J. Capper; *Bristol*, "The Dawn of Aerodynamics," by J. L. Pritchard; *Chester*, "Flight Systems for Transport Aircraft," by W. H. McKinley. Nov. 8, *Isle of Wight*, Annual Dinner. Nov. 12, *Glasgow*, "Uses of Electronic Computing Machines," by R. J. A. Paul; *Halton*, Film Show; *Henlow*, "Use of Plastics in the Aircraft Industry," by H. V. Potter. Nov. 14, *Leicester*, "Manned Flight into Outer Space," by T. Nonweiler. Nov. 16, *Birmingham*, "Silencing of Jet Engines," by F. B. Greatrex; *Luton*, Branch Dinner. Nov. 19, *Halton*, Film Show. Nov. 21, *Bristol*, Junior Members' Papers Competition; *Christchurch*, "Aeroplane Noise: A Challenge," by Prof. E. J. Richards; *Coventry*, "Some Influences of Equipment and Systems on Aircraft Design," by C. F. Joy; *Reading*, "Interplanetary Flight," by J. Humphries; *Weybridge*, "New Machining Techniques in the Aircraft Industry," by L. G. Burnard and T. A. Waite.

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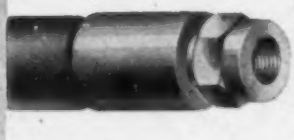

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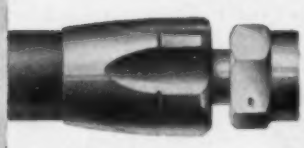

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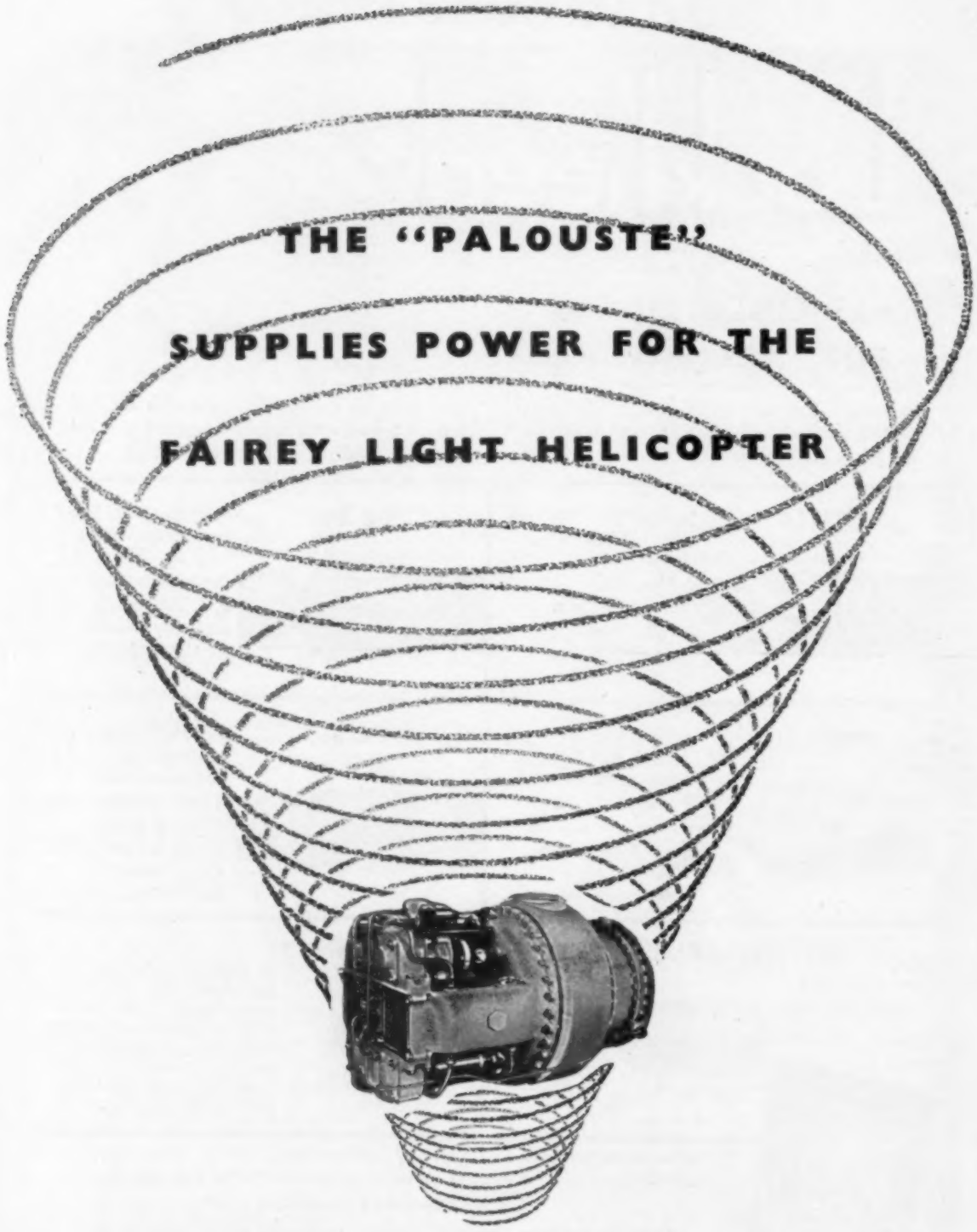

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ENGINE DIVISION

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An impression of the Boeing 707 in the livery of its latest purchaser.

CIVIL AVIATION

B.O.A.C.'s BOEING 707 ORDER

THE only element of surprise in the formal announcement last week of B.O.A.C.'s order for 15 Boeing 707-320s was the emollient news that the Corporation is considering also the purchase of a new and comparable British jet airliner—provisionally named the D.H.118. It is clear that discussions between B.O.A.C. and de Havilland on the exact specification of this aircraft—discussions which are still going on—have been the reason for the long delay in announcing the 707 purchase. (B.O.A.C.'s requirement for American jet airliners has been known since last May.)

We comment on this news in a leading article: here we record the bare facts as announced by the parties concerned.

The following statement was issued on October 24 by Mr. Gerard d'Erlanger, B.O.A.C.'s chairman, after Mr. Harold Watkinson, the Minister of Transport and Civil Aviation, had announced in Parliament that the Government had approved B.O.A.C.'s purchase of Boeing 707s, powered by Rolls-Royce Conways.

"I am convinced," he said, "that the acquisition by B.O.A.C. of large, high-speed and long-range turbojet airliners is imperative if the Corporation is to secure its competitive position on world routes, especially across the North Atlantic, from 1960 onwards.

"It is always the aim of B.O.A.C., of course, to fly British aircraft whenever and wherever practicable. Already the Corporation has ordered 33 Bristol Britannias, 19 de Havilland Comet 4s and 12 Vickers Viscounts (which are required for its associated companies). The Corporation's contracts outstanding for British aircraft, engines and spares represent total business for the British aircraft industry amounting to nearly £85m.

"Our decision to seek Government approval for the purchase of Boeing 707 aircraft, equipped with Rolls-Royce Conway engines, for operations in the Western hemisphere, was dictated solely by the fact that no comparable British airliner will be available at the time when this and similar long-range turbojet types are being introduced on the North Atlantic and elsewhere in the Western hemisphere by major airline competitors of the Corporation. Indeed, I am firmly of the opinion that unless we obtain this new fleet B.O.A.C.'s ability to maintain and improve its share of business over the highly important North Atlantic routes would be gravely jeopardized.

"In the meantime we are urgently discussing with the de Havilland Aircraft Company, Ltd., the technical details of an aircraft that will be sufficiently flexible to meet our requirements on our world-wide routes, including the North Atlantic. We shall need an aircraft with acceptable economies and outstanding performance. Such an aircraft should be ready to enter passenger service in 1962.

"Our plan for the Boeing 707s is to operate them on routes between Britain and the eastern seaboard of the U.S.A.; between Britain and Canada; between Britain and the west coast of the U.S.A., possibly across the polar region; and, subject to Government approvals, from Britain over the North Atlantic, the U.S.A. and the Pacific, to Australia.

"They will operate both first-class and tourist services and will be particularly useful in catering for the tourist traffic which is expected to develop to a very marked degree during the next few years.

"The value of the order for the 15 Boeing 707s is approximately £44m, including spare engines and overhaul spares. Of that total some £9m represents the cost of the British engines, spare engines and engine overhaul spares."

From de Havilland on October 25 came the following statement:

"Yesterday the Minister of Transport and Civil Aviation, Mr. Harold Watkinson, stated in the House of Commons that B.O.A.C. are intending to buy 15 American jets for service starting in 1960. He went on to say that the Corporation is urgently discussing with de Havilland the technical details of an aircraft to suit B.O.A.C.'s world-wide needs including the North Atlantic, to be in service by 1962, and that as soon as the specification is agreed B.O.A.C. will place an order.

"The de Havilland aircraft now under consideration is, for the time being, known as the D.H.118. Details of the specification are still being discussed but the intention is that the new aircraft should have speed and range capabilities comparable to the large American jets, but would be somewhat smaller in size. The carrying capacity envisaged would offer operational flexibility on the majority of the world's air routes, which did not have the large traffic potential of the North Atlantic. It would also be capable of operating in and out of existing mainline airports without calling for runway reconstruction and lengthening."

A de Havilland spokesman subsequently mentioned the possibility of the Rolls-Royce Conway engines being mounted in pods (contrary to the previous rumours that the so-called "Comet 5" would have buried Conway engines) and said: "The important thing is that it will be rather more flexible in passenger capacity than the big American aircraft and therefore more economical on the less busy air routes while still giving the range and speed of the large American machines."

Rolls-Royce, in a statement issued on the night of Mr. Watkinson's statement in Parliament, said that B.O.A.C. were the fourth airline to announce the Conway for long-range airliners [T.C.A., Air-India and Lufthansa have already ordered DC-8s or Boeing 707s with Conways.] "Two of the most important aircraft in B.O.A.C.'s fleet, Comet 4s and Boeing 707s, would thus be powered by Rolls-Royce gas turbine engines."

TEST OF FRIENDSHIP

STRUCTURAL testing of the fuselage of the Fokker F.27 seems to have vindicated many of the original features of the Fokker design philosophy. In bending tests made last summer it was found that the application of the ultimate load caused only a few small permanent buckles in the skin under one window—the doors, emergency windows and floor panels still fitted perfectly.

The fuselage/wing joint was designed by Fokker after a dynamic consideration of the whole aircraft during and shortly after the wheel spin-up period on landing. The test loadings have shown, claim Fokker, that an ample strength margin exists over those required by C.A.R. and that the stresses in the skin structure around the joint are better than predicted. Although strength of this order has been achieved at the cost of a slight weight increase, the fatigue stresses are low and an unusually high resistance of the fuselage frames to downward acceleration of the wing has been provided.

Particular care was taken in the design to avoid distortion and leakage of the pressure hull from wing and fuselage bending. The fuselage skin adjacent to the wing has been given flexibility by divorcing it from its reinforcing stringers and leading it into the underside of the wing. The stringers and three longerons run through the wing torsion box; the beam stringers are riveted to the centre section ribs, and are thus claimed to resist relative accelerations between the wing and the fuselage—a case which reaches a maximum in a wheels-up emergency landing. Furthermore, the floor and lower fuselage form a torsion box which is reinforced by twin beams running beneath the floor; these act as load distributors in the frames and provide the seats with supports that will withstand 20 g.

To reduce the possibility of fatigue caused by cabin pressure stresses, the stress level in the skins has been kept to 9,300 lb/sq in above the floor and 11,800 lb/sq in below; all riveted joints have been stressed to a level of three times working pressure.

An unusual feature of the window design is that the pane is *encastré* with the skin and window frame and acts as a membrane. Detail tests, according to Fokker, show that panels with the windows fitted are as stiff as adjacent panels without cut-outs.

CIVIL AVIATION . . .

Mr. John Cunningham, seen here on his arrival at New York International airport, to receive the Harmon Trophy for his round-the-world Comet 3 flight in December 1955. The presentation was made on October 23, by President Eisenhower.

SAFE AS AIRWAYS

HARD on the heels of the Guild of Air Traffic Control Officers' convention (*Flight*, October 12 and 19) came the announcement by Mr. Nigel Birch, the Secretary of State for Air, of revised procedures governing flight in controlled airspaces. This marked completion of a joint study of the problem made by the Air Ministry and the Ministry of Transport and Civil Aviation.

Since at the moment neither aircraft nor the air traffic control organization is geared to the complete ground control of all flights, the responsibility for avoiding collision must for many years, stated Mr. Birch, remain largely with the pilot. The most important change that had been found desirable was an increase in V.F.R. minima [this was done in August of this year by a third amendment to the Air Navigation Order, 1956].

The intention of this revision of the rules affecting clear-weather flying was to bring an increased number of flights under the surveillance of air traffic control, and to reduce the likelihood of collision in deteriorating weather conditions. The Ministers concerned have expressed the belief that this new regulation was "the most important immediate step which could be taken to increase aircraft safety."

Additional arrangements will make mandatory the filing of a flight plan and position-reports on airways under V.F.R. conditions. Civil aircraft will be required to notify their intention to cross airways, and they will be permitted to do so only in level flight.

A further recommendation of the inter-departmental committee which undertook the review is that measures should be taken to make aircraft more conspicuous by a careful choice of colours. The committee also propose that there should be an immediate study of what constitutes the minimum field of vision from an aircraft cockpit—a necessary review that is also the present concern of the U.S. Flight Safety Foundation. The upper limit of airways (at present 11,000ft) should, it is recommended, be raised so that adequate controlled airspace will be provided to cover the altitudes predominantly used by transport aircraft. All aircraft intending to fly in the vicinity of controlled airspace should also, unless under radar control, be able to fix their positions by means of aids and visual reference to the ground.

The particular requirements of military aircraft and research establishments and manufacturers are also recognized. If military traffic is to have freedom of movement from place to place and room in which to manœuvre in the course of operational and flying training, severe operational restrictions cannot be imposed, but as soon as the necessary facilities can be made available military aircraft will require to obtain clearance before crossing an airway. Suggested ways of doing this are by military ground controlled interception systems; by the radar controller of an A.T.C. unit; by an airways controller at an A.T.C. centre; or, as frequently at present, by reservation of the flying portions of controlled airspace.

It was clear, said Mr. Birch, that apart from the measures already adopted the main opportunity for more safe and expeditious control of air traffic lay in the greater employment of radar, and an examination had begun to see what additional radar was required.

B.O.A.C. have designed this handsome new sub-pantry unit for use in their Britannias. Extensive use has been made of grey Warerite metal-reinforced sheet for the work-top and beverage-container cover. The pantry, which was manufactured by Rumere, Ltd., incorporates a polythene waste-bin and a stainless steel wash-basin.

CONNECTION IN ICELAND

THE introduction of a new winter schedule for the Oslo-Reykjavik service was marked by a reception at Renfrew airport on October 20, at which Mr. Sigurdur Helgason, vice-president of Icelandic Airlines, said that in choosing Renfrew airport they hoped to make a small addition to its international standing. Aircraft from Oslo and Stavanger will leave Glasgow for Reykjavik at 3.45 p.m. in time to meet a connection from New York at the Icelandic capital.

The return sedvice from Reykjavik will arrive at Renfrew at 2.30 p.m. every Sunday and fly on to Stavanger and Oslo an hour later, providing a new direct service from Glasgow to Norway.

AIR TRANSPORT RESERVE AGAIN

THE suggestion that the Government should set up a military transport service operated by the R.A.F. was raised again by Mr. Geoffrey de Freitas in the House of Commons last week (Air Chief Marshal Sir Gordon Pirie's thoughts on the same subject were recorded in *Flight* of October 19).

Replying for the Government, the Under-Secretary of State for Air, Mr. Christopher Soames, said that he considered that the cost of setting up a separate Transport Command at the disposal of the Army would be prohibitive and he refuted any suggestion that the recent crisis had found Transport Command or the civil air fleet lacking. With the co-operation of B.O.A.C. and the independent operators, he said, the Air Ministry had been able to fulfil all the calls made on it without resort to any compulsory direction or requisitioning of aircraft. Mr. Soames added that more Comets and Beverleys would be introduced this year and would be followed by Britannias in 1958. By March 1959 the airlift capacity would be trebled over that available in March of this year, and he considered that the balance of advantage seemed to rest with existing arrangements.

SCOTTISH AIR

SPEAKING in Glasgow on October 20, Sir Patrick Dollan, chairman of the Scottish Advisory Council for Civil Aviation, said that B.E.A. and the Ministry of Civil Aviation were looking into the possibility of developing air traffic in areas of the Highlands and the Scottish islands where there were at present no landing strips. Answering a complaint that there were fewer available seats between Glasgow and Stornaway, Sir Patrick said that there were about the same number of seats available as there were last year, but that the service had now been stepped up to daily frequency. He denied reports that Wick and Aberdeen were receiving better service than Inverness.

Although passengers carried on B.E.A.'s Scottish routes in August increased from 42,118 last year to 50,175 in 1956, the freight traffic in the same months almost doubled. Sir Patrick accredited this increase to the fact that the type of goods carried did not have to be crated for transport by air.

A measure of the possibility of operating from islands without air strips or very little level ground, such as Skye and Harris, was recently given by the Scottish Aviation Twin Pioneer, which, during the royal tour of the Western Isles, was used to fly photographs from the islands to Glasgow. The prototype Twin Pioneer has now completed 360 hours of development flying and the second and third aircraft have flown about 150 and 50 hours respectively.

Red Indian visit: The Tu-104 pictured during a stop at Palam Airport, New Delhi, on October 17 during a proving flight from Moscow to Rangoon. Before landing at Delhi the aircraft made a stop at Tashkent and was airborne for six and a half hours. The registration number indicates that this is a later machine than the one flown to Peiping. (See "Flight," September 21.)

FIVE-POINT PROTEST

AT a two-day conference in Munich last week, sponsored by the German "Working Committee Against Noise" and attended by delegates from the United States, Britain and several European countries, a resolution was adopted demanding that (1) aircraft should not be permitted to fly lower than 3,250ft over populated areas; (2) weekend private flying should be confined to certain hours; (3) new airports should be built further away from densely-populated areas; (4) aircraft manufacturers should pay more attention to the problem of noise; and (5) anti-noise regulations should be included in international aviation codes.

SINGLE-SIDEBAND RADIO RESEARCH

BOTH in America and Britain, for some time past, intensive research has been devoted to the problems of developing radio equipment utilizing the single-sideband principle. The main difficulties, as reported from America, arise from the bulk of the equipment at present required for this type of transmission. Principal advantage is the enormously increased telephony range available. A range of several thousand miles has already been achieved with early equipment and the American Collins Radio Company now claims to have gone far towards effective miniaturization.

Tests carried out by the R.A.F. and R.A.E. in the Far East some time ago showed effective ranges of about 3,500 miles during trials. Now an R.A.F. aircraft has flown from Britain to Ottawa and Vancouver making R/T reports to the R.A.E. at ten minute intervals during the crossing. Development in Britain is being carried out by the Mullard Company and the M.o.S.

R-THETA DEVELOPMENT

A NEW version of the R-Theta navigation and interception computer was shown by P.S.C. Applied Research, Ltd., at the recent convention of the Institute of Radio Engineers in Toronto. Increased accuracy is claimed for this Mk 2 instrument, which is smaller and lighter than the Mk 1. The use of transistors has permitted a decrease in weight from 45 to 29 lb, and the reported accuracy of navigation is ±2 miles per 100 miles flown.

BREVITIES

BRITISH Aviation Services, Ltd., announce that Air Vice-Marshal S. D. McDonald, C.B., C.B.E., D.F.C., has been appointed managing director of the company.

* * *

The Ministry of Transport and Civil Aviation plans to re-open Gatwick in the spring of 1958.

* * *

Moscow Radio reported that Aeroflot had reduced fares on its internal air routes by 10 to 61 per cent for a return ticket.

* * *

Mr. Edmund Stohr has been appointed European director for United Air Lines, with headquarters in London.

* * *

The airport at Fuenterrabia (San Sabastian) has been closed to civil air traffic "for technical reasons" by order of the Spanish air minister.

* * *

Capt. M. J. R. Alderson has been appointed technical manager (flight operations) of B.O.A.C. and Mr. H. R. M. Roundell has been appointed staff manager (flight operations).

* * *

Yeadon joint aerodrome committee has recommended that the offer of the Air Ministry to purchase the aerodrome is not accepted and that negotiations should be opened for derequisitioning.

* * *

Captain Abdullah Baig recently became the first Pakistani pilot to command a P.I.A. Super Constellation on the Karachi-London route.

* * *

Negotiations between Bristol and Northeast Airlines were expected to have been resumed in Boston or New York last week. The airline is reported to be canvassing "all possible sources" of DC-6s to inaugurate its New York-Miami service this winter.

* * *

Gen. Claire Chennault, the former head of the "Flying Tigers," said in Tokyo recently that he did not expect his airline, C.A.T., to be nationalized by the Chinese National Government; nor had it ever been impressed into national service.

* * *

Holders of senior commercial and airline transport pilots' licences (other than those whose licences contain a helicopter rating) are reminded in a M.T.C.A. Circular that they require an instrument rating for licences to be valid.

Two B.O.A.C. Constellations will fly the Sadlers Wells ballet company to Moscow on November 11. The last B.O.A.C. aircraft to visit Moscow was the Lancastrian which flew the British Ambassador there in June 1949.

* * *

PanAm have announced that a contract for charter flights to start on November 3 has been signed with Aeroflot. The airline will fly the 418 members of the Russian Olympic team from Rangoon to Melbourne for next month's Games.

* * *

Mr. Harold Watkinson stated in a written Parliamentary reply that he has approved an application from PanAm to operate a service from London to Moscow through Warsaw, dependent upon the agreement of the Soviet and other governments concerned.

* * *

For the first time since the war a German airline is operating into Nuremburg. Deutsche Flugdienst, which is operated by Airwork, has just opened two new scheduled services from Frankfurt on behalf of Deutsche Lufthansa—one to Hamburg and Dusseldorf and the other to Nuremburg.

* * *

The possibility of a breakdown of the Philippine weather bureau's meteorological service, resulting in suspension of air services to and from abroad, was "not a distant possibility" according to representatives of the ten foreign carriers which serve the Philippines.

* * *

Mr. John Lankester Parker, O.B.E., F.R.Ae.S., M.S.L.A.E., was installed as Master of the Guild of Air Pilots and Air Navigators at Innholders Hall on October 17. Mr. Lankester Parker was Master from 1951 to 1953. On the same occasion an inscribed silver salver was presented to Mr. L. A. Wingfield in appreciation of his 27 years' service as Clerk of the Guild.

* * *

Private talks were resumed in London last week between Mr. A. H. Wilson and Mr. M. V. Custance, respectively deputy secretary and under secretary at the Ministry of Transport and Civil Aviation, and Mr. L. Satterthwaite of the U.S. State Department and Senator G. Gurney of C.A.B. They are discussing the revision of the bilateral civil air transport agreement (the 1946 Bermuda agreement).

Anglers All: Forming line-abreast off Malta are these three angled-deck carriers of the Mediterranean Fleet—H.M.S. "Eagle" (foreground), Flagship of Vice-Admiral L. M. Power, C.B., C.B.E., D.S.O., Flag Officer Aircraft Carriers; H.M.S. "Bulwark"; and H.M.S "Albion." The aircraft are D.H. Sea Venoms and Hawker Sea Hawks.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Prize Cadets

ONE cadet from each entry at No. 1 School of Technical Training at Halton and No. 1 Radio School at Locking will be selected for a prize cadetship, enabling him to go to the R.A.F. College, Cranwell, or the R.A.F. Technical College, Henlow. Nomination will be made by the Commandant of Halton and the Commanding Officer at Locking. It will not be necessary for the cadets to appear before a selection board. The scheme does not affect the present award of cadetships to Cranwell made by the selection board at the R.A.F. College.

Radar Inspection

AS the rôle of radar in air defence expands, the standards of radar control and reporting units must be increasingly efficient. The Air Ministry has formed a Control and Reporting Examining Team to inspect such units both at home and overseas. The team is headed by W/C. F. J. Trollope, M.C., who has many years' experience of radar control. It will be based at H.Q. Fighter Command and was due to start a tour of Fighter Command units at the end of October. Next year some overseas commands will be visited.

Hospital at Akrotiri

ALTHOUGH still housed in temporary buildings, the hospital at the R.A.F. airfield at Akrotiri, Cyprus, is well-equipped to suit the requirements of modern medicine. It is commanded by G/C. L. S. Everett, M.R.C.S., L.R.C.P., with a staff of 13 R.A.F. doctors, eight of them specialists. Nurses are members of Princess Mary's Royal Air Force Nursing Service and are in charge of Sq/O. D. G. Masters, the matron. Although run by the R.A.F., the hospital cares for patients of all Services and their families. Plans are being drawn up for the construction of a permanent hospital.

Back from Maralinga, where they dropped an atomic weapon, P/O. G. W. Ford and F/O. G. B. Spencer, members of the Valiant crew, display their far less lethal cargo on the return journey to Wittering. The flight was completed in 23 flying hours.

Radar Unit Command

IT is announced by the Air Ministry that S/L. S. F. Burley has been appointed to command No. 3701 (County of Sussex) Radar Reporting Unit, R.Aux.A.F., at Leahurst, near Brighton. Towards the end of the war he undertook intelligence duties for the Allied Expeditionary Air Force and later went to Australia for similar duties. After leaving the R.A.F. in 1946 he joined the R.A.F.V.R. in 1948 and the R.Aux.A.F. in 1953.

G.C.E. Examinations

THE General Certificate of Education examinations for R.A.F. personnel, conducted by the Cambridge Local Examinations Syndicate, began this week and will continue until December 4. A great variety of subjects can be offered, not all of them purely academic. Examination centres are provided for all three branches of the Services in Germany, the Middle East and Far East, as well as in the United Kingdom.

Numbers of R.A.F. personnel who attend are particularly high. Since the forces G.C.E. scheme began in 1953 more than 17,000 R.A.F. candidates have taken the examinations and 67 per cent of these were successful. Over 4,000 officers, airmen and airwomen sat for the examination in July this year.

South African Exercise

LECTURES and discussions formed the first phase of an air/sea exercise off the west coast of the Cape of Good Hope, and active operations are now in progress. South African, British and French forces are taking part.

Specialist Frigate

AN "aircraft direction frigate," H.M.S. *Salisbury*, was commissioned at Plymouth on October 22. She is the first of a new type of specialized ship; only limited information has been released about her, but she is presumed to have elaborate radar equipment, making the detection, direction and homing of aircraft possible anywhere on the high seas.

American R.A.F. Pilot Memorial

A CHAPEL to the memory of an American, P/O. James Neale Thorne, D.F.C., who lost his life over Arnhem in September 1944 while serving in the R.A.F., was dedicated in Birmingham Parish Church on October 22. P/O. Thorne's father, Mr. Samuel Thorne, who lives in New York and had contributed the major part of the cost of the chapel, attended the service.

Regimental Museum

OPENED recently at the R.A.F. Regiment Depot, Catterick, is a museum displaying the history of the regiment. Past or present members of the regiment who are prepared to loan or give items of interest to the museum are asked to send details to the Commandant of the R.A.F. Regiment Depot, Catterick, Yorks.

Random West

ABOUT 100 Canadair Sabre 5s will be returned to Canada from the R.C.A.F. 1st Air Division in France during November. Some have become surplus since the latest Sabre 6s have been delivered and others will be replaced by CF-100 all-weather fighters.

About half the Sabre 5s will be flown across the Atlantic *via* Prestwick, Keflavik, Bluie West and Goose Bay, while the remainder will be taken back on board the Canadian carrier *Magnificent* from Glasgow. The ferry flights will be code-named Random West.

On reaching Canada, some of the Sabre 5s will be issued to the six Auxiliary fighter squadrons stationed near Montreal, Toronto and Vancouver. Others will go to the day fighter O.T.U. at Chatham, N.B.

Reunions

THE annual dinner of the 7 and 14 R.N.A.S. and R.A.F. Handley Page Squadrons will be held at the Horse Shoe Hotel, Tottenham Court Road, London, on November 9. Tickets, price £1, from G. Conley, D.S.M., 62 Nightingale Lane, London, S.W.12.

A reunion of ex-R.A.F. and F.A.A. personnel who served during World War 2 at N.A.S. Pensacola, will be held in London on November 24. Particulars from L. V. Armstrong, 47 Rutland Road, Wanstead, London, E.11.

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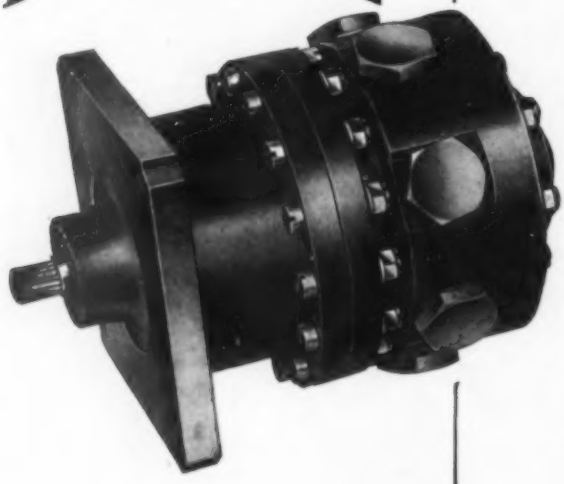

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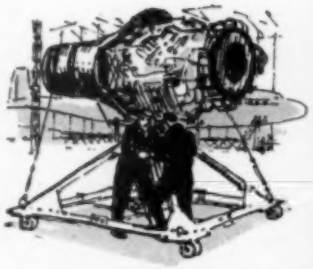

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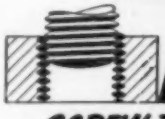

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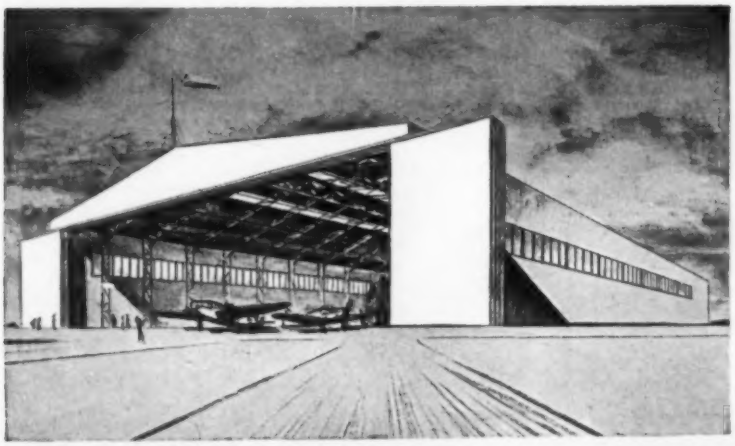

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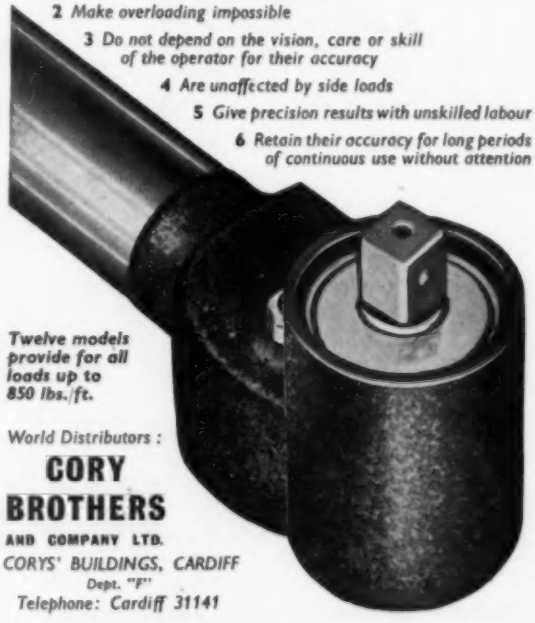

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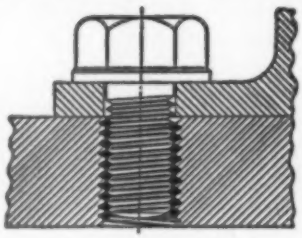

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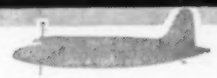

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PUBLIC ANNOUNCEMENTS

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APPLICATION No. 203/6. From Hunting-Clan Air Transport Ltd., of London Airport, Hounslow, Middlesex, for permission to include Frankfurt as an optional traffic stop on the area-to-area All Freight Service between airports in the United Kingdom on the one hand and various authorised traffic points in Malta, the Sudan, East, Central, West and South Africa on the other hand, which the Company have been approved to operate for the period up to February 22nd, 1965.

THIS application will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to this application must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making or representations or objections. [5870

PUBLIC APPOINTMENTS

SIGNALS OFFICERS CIVIL AVIATION DEPARTMENT FEDERATION OF NIGERIA

TO act as Station Telecommunication Officers at aerodromes in Nigeria and at Civil Aviation H.Q., Lagos. Station Telecommunications Officers are responsible for the operation and maintenance of aeronautical mobile and radio navigational aid equipment, the implementation of I.C.A.O. procedures and practices, technical administration in the telecommunications field and the supervision of junior staff.

CANDIDATES should be A.M.I.E.E., or have passed or been exempted from the Institution's examinations or hold a 1st or 2nd class honours degree in engineering or physics; should have at least five years' post qualification practical experience. A knowledge of modern theory and practice of radio and electricity and its application to air navigation is required.

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WRITE Director of Recruitment, Colonial Office, London, S.W.1, giving age, qualifications and experience. Quote BCD 98/14/01. [5862

GOVERNMENT OF CYPRUS

Air Traffic Control Officers

Civil Aviation Department

QUALIFICATIONS. Recognised course in Air traffic Control under R.A.F., R.N. or M.T.C.A. Recent experience as an A.T.C.O. preferably in a Flight Information Centre; experience in dealing with and co-ordinating Civil and Military aircraft movements involving the separation of jet and piston engined aircraft in a Control Zone; knowledge of Air Traffic Control, communications and navigational facilities and appreciation of the limitation of W/T, R/T and Radar Equipment. Previous flying experience advantageous.

DUTIES. Employment in the Nicosia Flight Information Centre on a 24-hour basis (shift work) under the direction of the Senior Air Traffic Control Officer. The Centre will be operated jointly with the R.A.F. and the selected Air Traffic Control Officers will be required to work in close co-operation with the R.A.F. Air Traffic Control staff.

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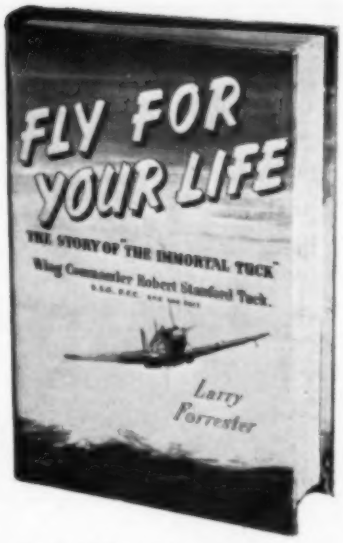

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SALARIES will be commensurate with experience and ability. If desired, private circumstances will be fully considered.

APPLICATIONS, quoting FP to the Technical Personnel Manager, Armstrong Siddeley Motors, Limited, Coventry. [5850

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MORTON AIR SERVICES require fully qualified radio officers home and overseas. Starting rate £885, plus generous overseas allowances. Apply Croydon 7171. [0477

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Applications should be made to the

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★ **SENIOR STRESSMEN**

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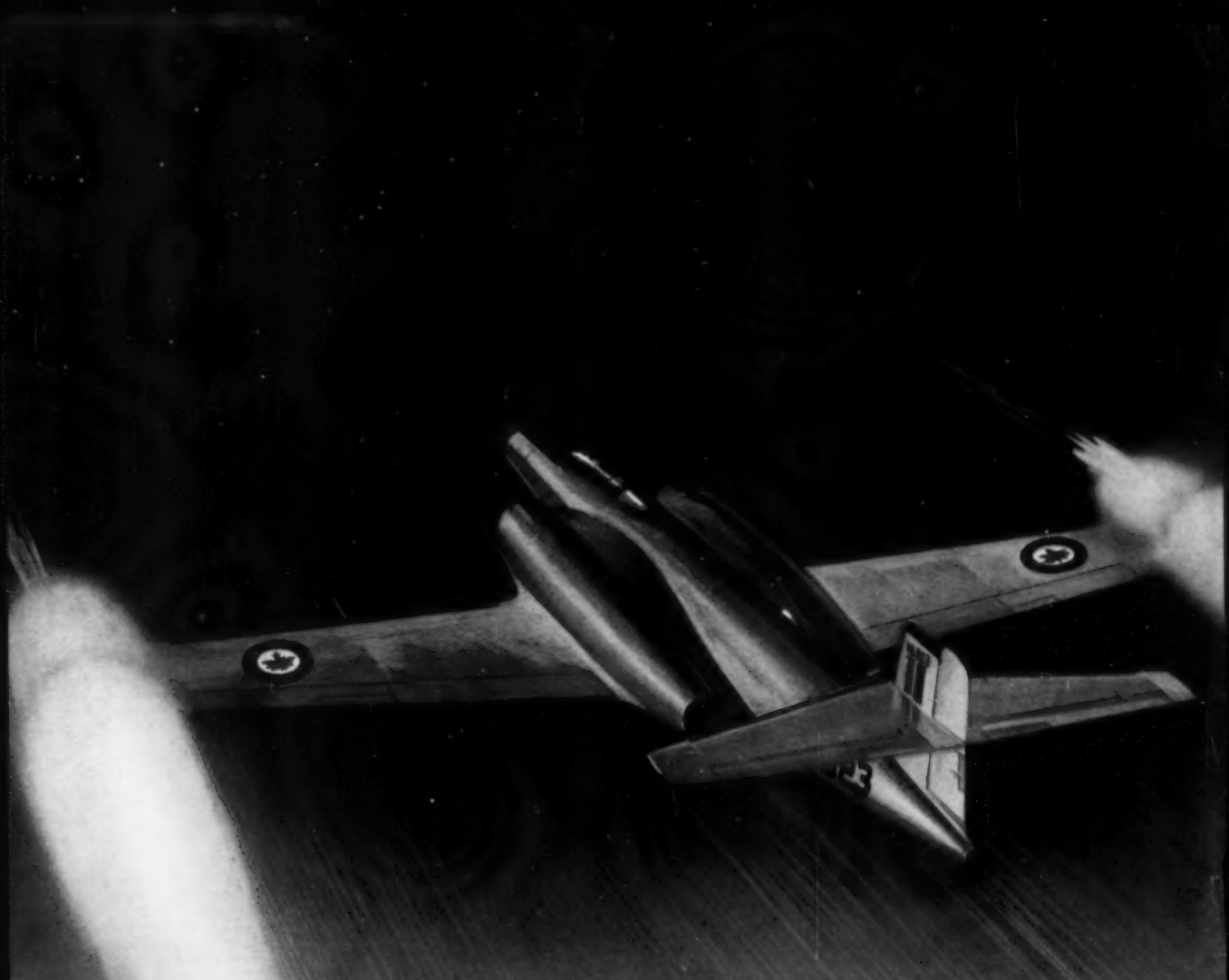

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